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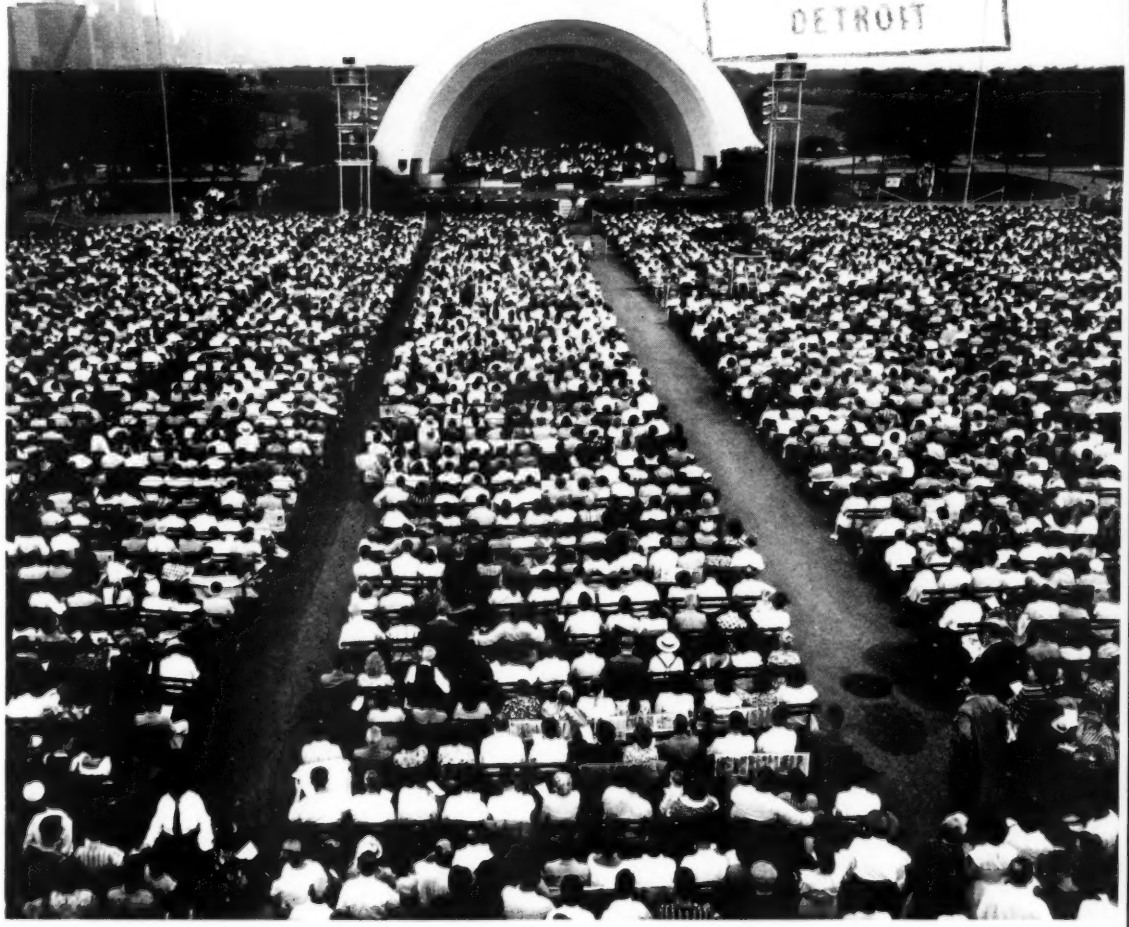

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ENGINEERING AND TECHNICAL PROBLEMS OF ATOMIC POWER — PAGE THREE

Vol. 6 August, 1953 No. 3

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MIDWEST ENGINEER
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BY
THE WESTERN
SOCIETY OF ENGINEERS
AT
2207 DODGE AVENUE
EVANSTON, ILLINOIS

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Single Copy .....$ .50
Annual subscription 4.00
Foreign subscription..... 6.00

Entered as second-class matter September 23, 1948 at the post office at Evanston, Illinois under the Act of March 3, 1879.

Midwest Engineer

A Publication of the

WESTERN SOCIETY OF ENGINEERS

Serving the Engineering Profession

AUGUST, 1953 Vol. 6, No. 3

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Of Atomic Power

Engineering and Technical Problems

By Dr. Walter H. Zinn

Frequently at conferences and forums I have been asked how soon this country will have an operating central station nuclear-fueled power plant. My answer has been "Four or five years after we have definitely decided to construct and operate such a plant." Bearing in mind that it takes three years to just construct a power plant with a nuclear reactor as the heat source, it is clear that I have allowed a year or so for design and engineering and no time at all for resolving doubts about the technical feasibility or for debating the merits of various ways of going about the job. Also, please note that this statement reflects considerable confidence in the technical feasibility which is quite a different thing than economic feasibility. If the question had been "How soon will we have an economically competitive nuclear-fueled plant?", I would avoid a direct answer by a statement such as this: "We will know what it takes to make an economically competitive nuclear plant only after we have gained experience in operating the first reactor which is designed and constructed specifically as a central station power plant. To date no such attempt has been made and so long as we put off making the attempt or as long as we devote almost all our technical efforts to devising reactors for manufacturing fissionable material or driving military vehicles, no significant answer to the question of economic feasibility can be given."

The cost of nuclear fuel

Fortunately, my task is the easier one of relating to you some of the important engineering problems of this subject. I realize full well, however, that the engineer can practically never let his imagination and technical genius flow unhampered by any question of money. So it is that the discussion must begin with a number of assumptions which encourage us to believe that the *cost* of fuel for a nuclear plant can be less than the cost of coal for present plants. In treating this topic, a rather basic difficulty is encountered since we are not allowed to know how much an operating company would have to pay for the uranium it used as fuel. We must then resort to speculating about the cost. Miners are paid $3.50 per pound for uranium while it is in the ore in the form in which it is mined out of the Colorado plateau. Arbitrarily, we will assume that its value is multiplied 10 times in putting it in a form suitable for use in a reactor and thus arrive at $35.00 per pound as the basic cost. Using the usual conversion figures, we arrive at the conclusion that if all of a piece of uranium is converted to fission products, the fuel cost of generating electricity is a little more than one hundredth of a mill per KWH. "How can this be a problem?" you ask, and I must hasten to explain that there are several points not yet taken into account. Most of natural uranium is U-238 and is called nonfissionable; in fact, 99.3% of it is the nonfissionable variety. You are reminded that the term nonfissionable as used here has a very special meaning. It means that this isotope of uranium (U-238) does not fission when it absorbs neutrons whose speed is in equilibrium with the medium in which they diffuse, hence, "thermal" neutrons. It does fission when bombarded by "fast" neutrons. Well, why not just use the 7/10 of one per cent of U-235 which the natural uranium contains and forget about the U-238? If it is proposed to actually physically separate the U-235, this requires an isotope separation process which is very costly indeed and yields a fuel cost for generating electricity which is too high. Pure, isotopically separated U-235 will be used in some of the military mobile reactors, but is not likely to be the fuel of atomic central station power plants.

Regenerative reactors

If the two isotopes of uranium are used together, we can take advantage of the fact that in a reactor more than heat can be generated. By allowing some of the neutrons released in the fission to be captured by the nonfissionable U-238, plutonium which is fissionable is created and, indeed, is so being made every day in the research and production reactors of the United States Atomic Energy Commission and in reactors in Canada, England, Norway, Sweden, France and presumably Russia. This regeneration of fissionable material, which takes place automatically and cannot be prevented if uranium in the form as provided by nature is placed in the reactor, makes all the difference. We see now that it isn't just the 7/10 of one per cent of U-235 which can be consumed but also some of the plutonium which is generated—and it is not necessary to physically separate the U-235 and U-238. The extent to which this regeneration process can be put to work depends on a number of factors which influence the design of the reactor in a major way. If for each quantity of fissionable material consumed, 80% as much plutonium is formed—that is, plutonium is formed with a conversion ratio of 8/10, a value easily reached in practice—the fuel available to the reactor is not just the amount of U-235 provided by nature but five times as much. This means that not only can a good fraction of the contained U-235 be burned, but actually a larger amount of U-238. A conservative appraisal of the situation permits us to postulate that 1% of all is burned and this gives a fuel cost which is not our earlier, unrealistic figure of 0.01 mills per KWH but more nearly 1.0 mills per KWH, a value comfortably below the fuel cost in a coal-burning plant.

To achieve greater percentage usage of the uranium requires higher values of the conversion ratio, until finally when the conversion ratio approaches 1.0 and beyond, a high percentage usage can be attained. Whether or not it can approach 100% (usage) will depend on the magnitude of the inevitable losses

(Continued on Page 4)

Dr. Zinn, Director of the Argonne National Laboratory, presented this talk before the American Power Conference in Chicago on March 25, 1953.

(Continued from Page 3)

not of neutrons in the reactor, for the conversion ratio includes these, but of material in the various chemical and metallurgical operations required.

What is wanted is a high conversion ratio, the higher the better; but there is no crucial significance to be attached to any particular value such as, for instance, whether it is slightly less or more than one. A high conversion ratio is necessary not only from the cost viewpoint but, more importantly, for the proper usage of uranium. With a high conversion ratio, uranium becomes a truly substantial energy resource.

Is there enough uranium?

It is pertinent to inquire as to how much uranium is required to keep a plant running and whether such amounts can reasonably be demanded from our mining industry? It is easier to think of this matter in connection with a generating station of conventional size, so we will imagine that our nuclear-fueled plant has an electrical capacity of 150,000 KW and a thermal efficiency of 25%. For an 80% load factor and the type of regenerative operation just described, namely 1% burnup, 20 tons of natural uranium are required annually as fuel. This is a modest amount and illustrates the advantage of nuclear fuel in the matter of transportation. How many such plants could be supported by our domestic production of ore is not known, but certainly it would be enough to get an infant nuclear-fueled power industry going. Technical developments will bring higher usage, permitting more and more nuclear plants.

Figure 2

MODERATING MATERIALS

Material	Relative Neutron Absorption per $cm^3 \times 10^3$	Number of Collisions Required to Thermalize	Absorption x No. of Collisions
Light Water	22	18	396
Heavy Water	0.06	25	1.5
Beryllium	1	86	86
Graphite	0.4	114	45

"How often would such a reactor need to have its fuel charge replenished?" is another question of some interest. It is a familiar fact that for a nuclear reactor to operate at all, it must contain at least the "critical amount" of nuclear fuel. For instance, the first graphite-uranium reactor, the University of Chicago experiment at Stagg Field, contained 41 tons of natural uranium. More than the critical amount of nuclear fuel can be charged into the reactor, but then some nonfissionable absorber of neutrons must also be added in order to maintain the reaction under control. Ordinarily, the coolant is such an absorber and thus we see that a practical graphite-natural uranium reactor would have a fuel charge in excess of the amount in the first reactor. Suppose we add the year's requirement of 20 tons for the 150,000 KW electric plant to the 41 tons so that the reactor is charged with 61 tons of normal uranium. Also, it is to be recharged when 1% has been consumed by fission. The reactor then requires a new fuel charge every three years. Or stated another way, this means any particular piece of uranium would remain in the reactor three years. I am sure it would be a novel experience for the operator of an electric plant to shovel fuel into his furnace so slowly that it takes three years from startup to handle the first ashes. Reactor operation is not uncomplicated as this and some of this presumed advantage vanishes when one looks at the problems connected with exposing a piece of nuclear fuel for a long time to intense radiation and to corrosive coolants, while all the time up to two atomic percent of impurities in the form of radioactive fission products are being generated within the fuel.

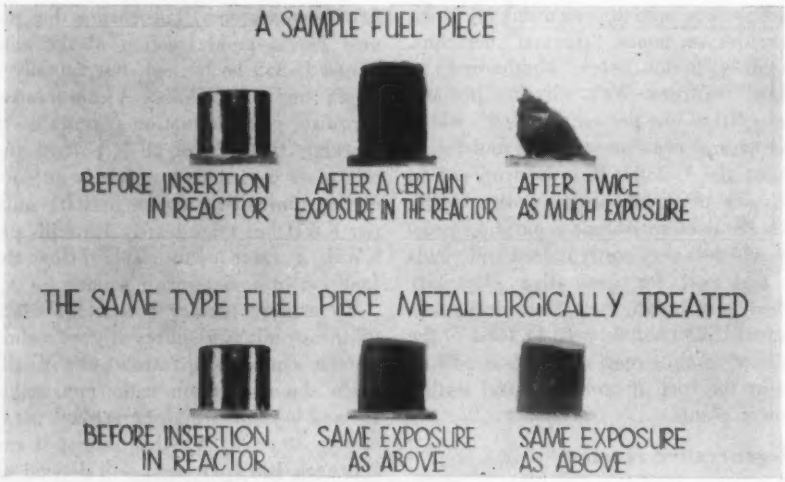
A SAMPLE FUEL PIECE
BEFORE INSERTION IN REACTOR
AFTER A CERTAIN EXPOSURE IN THE REACTOR
AFTER TWICE AS MUCH EXPOSURE
THE SAME TYPE FUEL PIECE METALLURGICALLY TREATED
BEFORE INSERTION IN REACTOR
SAME EXPOSURE AS ABOVE
SAME EXPOSURE AS ABOVE

Figure 1. Physical changes due to radiation in a reactor.

Radiation Damage

Generating impurities in the fuel while it is being violently bombarded by the fission product fragments and fast neutrons can cause physical distortion and even collapse. Deterioration of fuel under such bombardment is called "radiation damage." An example of radiation damage is shown in Figure 1. These pictures show a research sample of nuclear fuel which was heavily exposed in a research reactor. Originally the samples were smooth metal cylinders but as exposure progressed, physical changes set in. Greater exposure causes greater effects but, as is shown in the second line, this is a problem amenable to attack by research methods.

Moderator Materials

So far we have dealt only with problems directly connected with the uranium fuel, but there are others connected with the fact that enormous amounts of heat energy must be carried from the fuel to the steam generating equipment. Con-

sideration must be given to the choice of moderating materials, structural materials, and most important the cooling medium.

Figure 2 gives an estimate of the relative effectiveness of the four moderating materials—ordinary water, heavy water, beryllium, and graphite. In the second column, the relative appetite of these for wastefully absorbing thermal neutrons is given. This, however, is only one of the criteria for selecting a moderator. A second criterion is the number of collisions required to slow a neutron down from its velocity as emitted in fission to the thermal energy. Since it is desirable to have both absorption and the number of collisions small, a useful measure of effectiveness of the moderator is the product, which is given in the last column. On this basis, heavy water is superior and light water least desirable. However, availability and cost must also be considered and these considerations may be overriding. In the early stages of this development, graphite was chosen over heavy water because of its availability. Beryllium is costly and suffers the added disadvantage of being a substance which presents a very subtle health hazard. Despite its poor standing in Figure 2, light water is always worth considering as a moderator because of cheapness and availability. It should also be clear that in a power reactor, high temperatures are involved and for this reason graphite and beryllium are especially suited. If water is to be used as moderator, it must be either insulated from the high temperature of the fuel or pressurized.

Structural Materials

In Figure 3, some structural materials which have been or could be used in reactors are listed. All physical properties of contemplated structural materials are important, but we will confine our attention to a few. In the second column, relative neutron absorption per unit volume is indicated. This alone is not enough since the strength of the structural member will determine how much is to be used. In the third column is listed the relative neutron absorption for pipes of equal strength and identical internal diameters. The great superiority of zirconium for this use is immediately apparent. Magnesium and aluminum, although much better than stainless steel, are ruled out for a power reactor because of corrosion difficulties and low melting point. Steel and zirconium are the likely prospects for the construction of pipes and supports for the internal parts of an elevated-temperature reactor. Steel imposes a severe penalty on the reactor operation because of its large parasitic capture of neutrons. It is not surprising that the AEC and its contractors have expended a large amount of effort in obtaining and learning how to use purified zirconium metal. Unfortunately, zirconium occurs with hafnium from which it can be separated only with extraordinary difficulty. The natural zirconium-hafnium mixture is no improvement on steel with regard to neutron absorption. Not indicated in the figure is a very important question regarding structural material, namely, corrosion resistance. This cannot be considered without specifying coolant and is a question to which we will return.

Figure 3

STRUCTURAL MATERIALS

Material	Relative Neutron Absorption per $cm^3 \times 10^3$	Relative Neutron Absorption for Pipes of Equal Strength (20°C)	Melting Point deg. F.
Magnesium	3.5	10	1200
Aluminum	13	102	1230
Stainless Steel	226	234	2730
Zirconium	12.6	16	3330

Reactor Coolants

Figure 4 is a comparison of various coolants which are being used or have been suggested for power reactors. Column 2 lists relative neutron absorption. Helium rates best on this account, with heavy water, bismuth-lead, sodium, and light water following in that order. Our reactor makes power and therefore the coolant must permit operation at some elevated temperature and must permit a sizeable temperature rise as it passes through the reactor. Some assumed temperature increases are shown in column 3. A large temperature rise is desirable so that the nuclear fuel in the reactor can be efficiently used. The fuel is costly and unless energy is extracted from each unit volume at a high rate, inventory charges on the fuel will be damaging for the cost of the final product. The average heat flux which these coolants permit is given in column 4.

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Figure 4

COOLANT COMPARISON

Coolant	Relative Neutron Absorption per $cm^3 \times 10^3$	Assumed Temperature Rise deg. F.	Average Heat Flux Btu/sq. ft. hr.	lb/min/MW (Pump Power)	sq. ft. /MW (Reactor Size)
Helium at 2,000 psi	0	1,000	5×10^4	41	68
Light Water	22	180	50×10^4	316	6.8
Heavy Water	0.06	180	50×10^4	316	6.8
Sodium	11	360	200×10^4	500	1.6
Bismuth Lead	3	180	50×10^4	5,600	6.8
Oil	——	——	——	——	——

(Continued from Page 5)

What is *average* is a matter of choice; heat rates of one million B.T.U./sq. ft. hr. are high but necessary for the power reactor. In the fifth column, the mass flow of coolant per unit of power output is given. This is only one of the factors which determine pumping power, but it indicates the relative standing of the coolants. Pumping power is a direct drain on the salable power; consequently, high pumping charges should be avoided. We see that the heavy liquid metals carry a considerable handicap in this regard. If we consider the volume rather than mass flow, helium also rates unfavorably with respect to pumping power. In the last column, the square feet of cooling surface required per unit of power is shown. Generally speaking, this will determine the reactor size, and it can be assumed that reactor size, the cost of building the machine, and the inventory charge on the fuel are more or less proportional. Pressurized helium appears to call for a relatively much larger reactor than either water or liquid metal. High pressure and large size is a combination which poses its own special engineering problems. With these arguments before us, it is understandable that the Hanford Works reactors are water cooled, that the Argonne National Laboratory-Westinghouse designed submarine reactor is water cooled, and that the General Electric designed submarine is sodium cooled.

Oil is shown in the figure without any guesses as to performance figures. Irradiation causes dissociation of compounds which is one of the reasons liquid metals are used as reactor coolants. In the case of water, the dissociation products are gases and can be managed. Without specific data on a particular oil, a comparison cannot be made but it is listed merely to indicate that the possibility exists.

It is of interest to speculate on how well these coolants meet the requirements of a power reactor. If we consider our 150,000 KW electric plant which has a fuel charge of 61 tons, we can make some approximations of the heat transfer requirement. Suppose the uranium is spread out into a sheet 0.5 inches thick and is cooled on both sides. This gives a total cooling area of 4500 square feet and provides 7.2 square feet for each MW of thermal power of the reactor. This is a figure which just can be met by the liquid metals and water, as is indicated in the last column of Figure 4, using the average heat fluxes given in column 4.

From the above it follows that a future power reactor might very well be described as follows:

(1) It is fueled with both U-235 and U-238.
(2) It is cooled with light or heavy water under pressure or with liquid metal.
(3) It uses light or heavy water or graphite as moderator if there is a moderator.
(4) It has cooling tubes and other internal parts made of zirconium or stainless steel.

Corrosion

Special mention must be made of corrosion. With high heat fluxes, cooling surfaces must not foul. Also, corrosion products in the circulating fluid become radioactive and add to the maintenance and shielding difficulty. High-temperature, high-pressure water is a fairly corrosive medium, but with proper treatment is usable. Fortunately, zirconium is quite resistant to attack under these conditions. Hot sodium presents few corrosion problems for the metals in the middle of the periodic table, especially if precautions are taken to keep it free of contaminants, notably oxygen.

The corrosion resistance of the uranium fuel itself in the coolant atmosphere is a vital point. All coolants with the exception of helium, when passing through a reactor become radioactive. This radioactivity is usually associated with just one nuclear species and decays with a specific half-life. For instance, in the case of water the induced radioactivity has a half-life of eight seconds and therefore a very short time after leaving the reactor this radioactivity vanishes. Sodium becomes radioactive with a half-life of fifteen hours and, although it takes several weeks for this radioactivity to die to a negligible amount, it does disappear. If due to corrosion any of the uranium fuel gets into the cooling stream, it carries with it fission products and some of these have half-lives as much as several years. This means that a cooling system contaminated with fission products will remain permanently radioactive unless cleaning measures can be effectively instituted. This is difficult.

For these reasons, in a water reactor a protecting sheath on the uranium is used. Compatibility, corrosion-wise, of the uranium fuel with its coolant has a great deal to do with the extent to which the protecting sheath must be made perfect. If the hot fuel corrodes very rapidly so that measures to shut off the machine

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WSE Prize Paper

The Engineer and the Prospective Employer

By Lillian Stemp, MWSE

At one time or another practically every engineer is confronted with the advisability or necessity of changing his employment. When that time comes, the engineer who can present his qualifications properly will find the right employer for his particular services.

To assist engineers in determining what this proper presentation might be, presidents and other top executives, chief engineers, university counselors, private employment agencies and professional association employment services were consulted. Each expressed the opinion that despite the apparent shortage of engineers, full utilization of engineering skills is not being realized. One of the reasons advanced was that many engineers are not aware of the procedure that would help them sell their skills to prospective employers.

In this connection, a chief engineer commented that practically all of the engineers whom he had interviewed in the last few years entered his office with an attitude of "I am an engineer. You sell me on whether or not you want my services!" This was not done in a boastful manner, but reticence on the part of the engineer to sell himself made it appear as a challenge. The chief engineer said many of the applicants guarded their abilities and interests in such a secretive manner that only after an invitation to a cup of coffee could they be induced to talk about themselves.

Lillian Stemp, safety engineer and technical writer, was awarded $100 for this article by the Western Society of Engineers at the Society's annual dinner on May 25 in Chicago.

If an employer can ascertain that a particular engineer's training and ability will be an asset to his organization, he will want that engineer. Bonnell H. Allen, manager of the Engineering Societies Personnel Service, Inc., expressed this same thought in his pamphlet "How to Secure a Better Position." He stated: "Your entire life with its educational training, hobbies or leisure time activities and your business experience combined with your own natural abilities have given you training and knowledge along certain definite lines which are valuable to the right employer."

In presenting his qualifications, the engineer can choose to make his first approach either by writing or by having someone else do the initial groundwork and then take over from there. Once the contact is established, the personal interview follows.

Putting it in writing

Brevity in the first approach is important. Business and professional people are harassed by their lack of time to peruse today's vast amount of necessary reading matter. The short letter from an unknown is more likely to receive a top executive's prompt and thorough attention than a lengthy letter. One of the executives who was consulted about this matter said: "I want to know, first of all, an engineer's past work experience. I want to be able to evaluate quickly if what he has done in the past meets my company's present or future needs. I want some idea of his schooling so I can determine his future possibilities in the organization. Finally, I want some idea of his age."

After such information is furnished briefly, there is sufficient time to call the engineer in to talk about other points. These points, as important as they may be in the final decision to employ the engineer, are matters which can best be presented in a personal interview. For example, it takes considerable narration to relate why an engineer wants to make a change in employment, why he thinks he would like to work for his prospective employer, what he has done to become acquainted with the employer's type of business, what his qualities of leadership are with supporting information such as an account of offices he has held in societies and organizations, difficult engineering problems he has undertaken and solved, and so on.

Success with a brief approach is exemplified in the following incident. When a tool engineer's employment was about to be terminated, he prepared a four-page, single spaced, typed brochure, made carbon copies of it, and mailed these out to prospective employers. (Although the more elaborate brochure, when properly prepared, has a definite place in the presentation of qualifications, it is not recommended as a first approach.) His presentation was not effective in creating any interest among those employers. The tool engineer then sought the help of a private personnel service. Their staff condensed the appli-

(Continued on Page 8)

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cant's information to a one-page folder. An employer was immediately interested. The engineer was offered an assignment as Chief Tool Engineer at a starting salary of $575 a month with a substantial increase after 30 days. The man is utilizing his maximum skill since he has taken on additional responsibilities with his new employer.

"Situation wanted" advertisements placed in professional association publications, business and trade journals are effective media for the engineer. Those inserted in newspaper columns, while successful for some types of positions are not considered suitable for the engineer. A number of years ago, the head of a private employment agency offered to wager that a suitable position would not be obtained by capable engineers through situation wanted advertisements in the newspaper. In the ten years he has been in business, he has not found one taker.

None of the executives interviewed had the time to read the situation wanted columns in the newspaper. Someone down the line in the organization might read them, but that person may not be aware that the president is germinating the idea of having an engineer in the organization. This is especially true in small prosperous plants. The executive in such a company looks to his business and trade journals for information about his industry. He is personally more apt to read the situation wanted advertisements in these publications. They are fewer and more pertinent to his needs.

The Western Society of Engineers' publication, *Midwest Engineer*, carries a situation wanted section under the more dignified heading of "Engineers available," prepared by the Engineering Societies Personnel Service. These advertisements, though brief, impart the type of information that captures the interest of executives—namely, age, past work experience, degree, and salary desired.

Letting someone else do the initial groundwork

Private and association employment services are available to do the initial groundwork for the engineer with inconvenient or limited employment-seeking time. While there are poor employment services, there are also many good ones. The assistance of the latter should not be overlooked because of the reputation of the former.

Members of professional engineering societies have access to services provided by their respective organizations. In the case of the Western Society of Engineers, there is the Engineering Societies Personnel Service, Inc., with offices in Chicago, Detroit, New York and San Francisco.

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In addition to the time and convenience aspect, there are many other advantages in using private and association employment services. For example, they enable the engineer-applicant to go directly to the interested executive, often by-passing a battery of clerks on whom a recitation of the engineer's qualifications would be largely wasted. This situation is best typified by an engineer who canvassed practically every plant in a certain area without success. When he availed himself of the services of a local private employment agency, two of the companies which had previously turned him down now wanted him. He was placed in the position of trying to decide with which of the two *he* wanted to affiliate himself. Later he explained that the employment personnel with whom he had his original contacts had had no knowledge that openings were available for an engineer. It was a case of the plant president himself not knowing, until the private agency called his attention to the qualifications of the engineer. He had been "thinking" about someone like this engineer and now that he was available, he wanted him.

Another advantage is that the staff personnel at employment agencies, private or association, are in a position to help groom the engineer for his prospective employers. Recently, an applicant with a bachelor of science degree in electrical engineering called at the offices of a private employment agency. He had been graduated from Michigan State in 1935. Unable to find a position as an engineer at that time, he accepted work in a steel mill. He had been promoted to an electrical turn foreman and had remained on the same job for the last four years at a salary of $473 a month. He wanted to utilize his full skill as an electrical engineer, but he had been out of touch with employment seeking for so long he did not know how to go about it. He was coached on how to sell himself. The result was his placement as an electrical engineer at a starting salary of $600 a month.

The interview

Preparation for the interview conserves the engineer's time as well as that of the prospective employer. A change in employment is usually one of the major

(Continued on Page 15)

Human Relations in Management

By T. D. Hartsell, MWSE

The engineering profession has produced many marvelous products. In communications, for example, we might name television, radio and the telephone. Regardless of how important these things seem to us, there still is nothing that compares in importance with people. Today we want to focus our attention upon a specific group of people—engineers.

Sixty years ago there was just one engineer for every 290 workers. Today there is one for every 50 workers. That is an increase of 600 per cent and all indications point to a continued growth in the ratio. It is quite obvious that there are and will be more and more engineers competing for supervisory and management jobs. A vital question is raised, "Is the engineer prepared to be a supervisor?"

Some people have been concerned already about this question. About two or three years ago the Education Committee of the Western Society of Engineers sent a questionnaire to the top management of numerous concerns in and around Chicago inquiring as to the engineer's greatest weakness with regard to being prepared for assuming jobs of greater responsibility. The tabulation of replies showed Human Relations in first place with Business Administration next. This focuses attention on the subject of Human Relations. Since it seems to be of great importance, suppose we find out something about it.

We will start with the very fundamental principle that every result is caused. Narrowing down to an individual, we find that his behavior results from a stimulus. The stimulus may be inside the individual as with pain for instance, or it may be outside. Since the stimulus outside the individual will be of much concern to us, suppose we refer to it as Stimulus in the Situation, or "Situation" for short.

Put another way, an individual's behavior will depend upon his own interpretation of a given situation. For example, several people travel by bus to a lake. Some of them will go fishing, others will go swimming, still others will go boating and some will be content just to sit on the shore and appreciate the wonders of nature.

There are many factors that influence an individual's interpretation. One is his motives, or wants and desires. They are inside the individual and are the main springs to action. A level of aspiration is an example. Without a goal to work toward, a person's existence lack's the satisfaction of accomplishment. Motives can conflict and the individual may be forced to choose one and abandon the other.

Incentives

Factors in the situation which satisfy an individual's wants are called incentives. They can be termed as positive and negative. Praise is one of the most effective positive incentives. Punishment is a negative kind and is effective in breaking bad habits after other approaches have failed. Just last night a newscaster referred to an instance where three teen-age girls caught a policeman writing a ticket for illegal parking of an automobile belonging to one of them. They objected, grabbed his night stick and fled. They were captured later and were taken to their homes where the parents stated that they were no longer able to control the actions of their children. The newscaster wondered whether there had been a lack of the use of a paddle when needed, and might it not be a good idea to use one now. The paddle of course is a negative incentive.

Frustration

Another factor, and a very major one, that influences interpretation of a situation is frustration. It results from an effective blocking of an individual's goal. It generally results in some change in the individual's behavior pattern. The most usual reaction is one of attack which may be either verbal or physical. Starting adverse rumors is a form of indirect attack. Another reaction is escape. The individual tries to get away from the situation that frustrates him. Giving up is another form in which the individual thinks "What's the use?" Childish behavior is an immature reaction. The person can give excuses rather than the real reason for his failure to achieve a certain goal.

It is not important that a person's behavior be classified by one of the five kinds we have mentioned but it is important to detect any change in his usual behavior. The change can be a danger signal.

Somebody once inquired how soon a supervisor should begin to solve the frustration of an employee. The answer might be found in the following illustrations. A family we know has a mother who is a graduate nurse. She is always watching her children for symptoms. When they show any indications of paleness or of being flushed or their temperature goes up one-half of a degree, she consults the doctor. That family has in effect bought a yacht for the doctor and owns a wing of a hospital. Another family never pays any attention to its youngsters who sometimes are incapacitated for considerable periods of time because of neglected care. Obviously the proper time to give attention is somewhere between these extremes. Considerable judgment is required to determine just when. That is the difficult part of dealing with the human equation. It is more important to prevent frustration than to have to relieve it after it occurs.

A supervisor usually puts frustrating conditions in front of an individual for the purpose of developing him. That method has been used in schools for years. It must be good. Hurdles are put in front of the runner. The problem of the supervisor is to decide just how high to make the hurdles to extend the individual yet not make him stumble and

(Continued on Page 18)

T. D. Hartsell, Division Plant Engineer, Illinois Bell Telephone Company, and an instructor in Human Relations in Management on the Joint Educational Committee, gave this talk at a noon luncheon meeting of the Western Society of Engineers on April 29, 1953 at the Society's Headquarters in Chicago.

New officers: front row, left to right, Charles S. Doerr, Engineers' Club of Philadelphia, treasurer; Ernest Hartford, ASME, president; M. C. Turpin, ASRE, secretary; E. H. Robie, AIME, vice president. Back row, O. Laurence Angevine, Rochester Engineers' Society, director; H. H. Henline, AIEE, director; T. J. Ess, AISE, director; and J. Earl Harrington, WSE, director.

Society Secretaries Convene

The annual meeting of the Council of Engineering Society Secretaries at the Chalfont-Haddon Hall, Atlantic City in June was one of the most successful and well attended in the history of the organization. Over 35 engineering societies were represented.

Excellent presentations were made and discussions held on topics pertaining to society operation. Outstanding among these was the "Symposium on Modern Office Procedures" representing over six months work by a panel of four members in the preparation of a complete reference brochure that was distributed to those in attendance at the meeting.

Another feature of the meeting was an exhibit of Promotional Material.

New officers elected:

President .... Ernest Hartford (ASME)
Vice President ... E. H. Robie (AIME)
Secretary ..... C. S. Doerr (Engineers' Club of Philadelphia)
Treasurer ..... M. C. Turpin (ASRE)
Directors ..... **J. Earl Harrington (WSE)**
H. H. Henline (AIEE)
T. J. Ess (AISE)
O. L. Angevine (Rochester Engineers' Society)

Retiring from the board this year were Director Col. W. N. Carey (ABCE) and Secretary F. G. Horton (Engineers' Society of Detroit).

Front row, left to right, J. Earl Harrington, WSE; Col. Wm. N. Carey, ASCE; Frank G. Horton, Engineers' Society of Detroit; O. Laurence Angevine, Rochester Engineering Society; Ernest Hartford, ASME; H. H. Henline, AIEE; M. C. Turpin, ASRE; E. H. Robie, AIME. Middle row, H. E. Conrad, ASTE; N. S. Hibshman, AIEE; J. G. Magrath, American Welding Society; L. Austin Wright, EIC; T. J. Ess, Association of Iron and Steel Engineers; Paul H. Robbins, NSPE; John A. Zecca, ASCE; Robert Painter, ASTM; A. R. Putnam, ASTE; Charles S. Doerr, Engineers Club of Philadelphia. Back row, G. G. Taylor, ACS; R. M. Warren, ACS; W. P. Youngclaus, ASLE; Charles S. Pearse, American Ceramic Society; K. F. Treschow, Engineers' Society of Western Pennsylvania; J. R. Kitson, AICLE; A. V. Hutchison, ASHVE; and G. P. Paine, ASA.

New Prestressed Bridge of a Pre-Tensioned Design to Be Constructed in Illinois

A new type of prestressed concrete bridge will be erected for the first time in Illinois, near Henning in Ross Township.

Bridge superstructure beams are of the new pre-tensioned prestressed concrete type. The revolutionary beams get enormous structural strength from a special steel strand developed by U. S. Steel's American Steel & Wire Division. The strands have been placed under tension and locked in the concrete beams to prevent them from cracking under extreme loads.

Highway officials, bridge contractors and engineers are studying the new process as an economical and safe means to construct new bridges, as well as replace worn ones, in this and other states. Some eastern states already are using pre-tensioned beam bridges with highly satisfactory results.

"With this type of bridge beam, we expect to meet two primary objectives—replacing hazardous bridges with ones that are durable to hard usage; and doing the job economically," said Charles N. Lane, Vermilion County superintendent of highways, Danville, Ill., who will supervise construction of the bridge.

The heart of this type beam is a series of ¼-inch diameter steel wire strands stretched taut by applying pressure to the ends equivalent to 135,000 pounds per sq. inch stress on each strand. Concrete is poured into a beam form around the wire strands and welded wire fabric stirrups. Bonding properties of the concrete keep the strand permanently under stress within the beam. Pressure of this reinforcement enables the beam to carry

Stratton Signs Engineering Bill

Ralph R. Bartelsmeyer, president of the Illinois Engineering Council, recently announced that Governor Stratton had signed House Bill 451 on June 16, 1953.

The bill was sponsored by the Illinois Engineering Council and amends the Illinois Professional Engineering Act by deleting an obsolete section and providing for recent engineering graduates to be enrolled as an Engineers-in-Training.

The amendment defines the "Engineer-in-Training" as a person who is a candidate for registration as a Registered Professional Engineer and who has been enrolled as an Engineer-in-Training. To be enrolled an applicant must have graduated from an engineering college and have successfully passed the academic portion or first part of the examinations. The enrollment is valid for a period of ten years exclusive of any time spent in military service. Upon completion of the required additional four years of professional experience, an Engineer-in-Training is eligible to apply for the second part of the examination and if successful will be issued a Certificate of Registration as a Professional Engineer.

Over twenty other states have provided for the Engineer-in-Training in their Professional Engineering Acts. This amendment now permits reciprocity between the State of Illinois and these states in recognizing Engineers-in-Training.

The Illinois Engineering Council is made up of representatives from sixteen of the leading engineering societies in the State of Illinois.

Western Society is Represented

The Western Society of Engineers is represented on the Council by the following members: Herman Halperin, E. R. Hendrickson, W. R. Marston and Frank V. Smith. W. R. Marston is secretary-treasurer of the Council and E. R. Hendrickson is a member of the Executive Committee.

The Western Society of Engineers is also well represented by members who have been appointed to the Illinois Engineering Council by other engineering societies. George C. Laughlin represents ASME on the Council and is a member of the Executive Committee as is W. A. Kuechenberg who represents ASHVE. D. K. Chinlund, representing AIEE, is chairman of the Finance Committee. John F. Sullivan, Jr., representing ASME, is chairman of the Legislative Committee. In addition a number of other members of the Western Society of Engineers serve on different committees of the Illinois Engineering Council.

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designed loads, while using less materials than other conventional reinforced concrete designs.

Beams for the Ross Township bridge are to be three feet wide, 30 feet long and 17 inches deep. They are being manufactured by the Mid-West Prestressed Concrete Co., Springfield, Ill. Bridge contractor is Harold O'Neil of Danville.

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Atomic Power

(Continued from Page 6)

and reduce the temperature are not effective before a sizeable amount has entered the cooling stream, troublesome contamination can result. If the reactor must be shut down frequently for such maintenance, its value as a source of power is much depreciated.

This aspect of corrosion is in addition to the usual one of interference by the corrosion products with the heat transfer properties of surfaces. It makes corrosion research basic to the development of nuclear reactors.

In comparing the two most likely coolants, sodium and pressurized water, we can strike a balance sheet something like this. Although the pressures required for water-cooled power reactors are not phenomenally large, making the system tight against leakage of radioactive water vapor is a new engineering problem. It calls for the development of such devices as canned rotor pumps, as has been done for the Argonne-Westinghouse submarine reactor. By and large, however, the engineering of the pressurized water system can call very heavily upon established methods since, after all, hot water is not a new thing in the power industry. Sodium with a boiling point of 1616°F requires no pressurizing. It can be brought out of the reactor at as high a temperature as corrosion and the general management of a very radioactive substance permit. The integrity of the piping system must be beyond question and may require the development of such devices as double-walled piping systems and electromagnetic pumps. Electromagnetic pumps are completely sealed and require for their operation only that a current of electricity pass through the pipe carrying the liquid metal. Higher temperatures are possible with sodium than with water, thus leading to more efficient conversion to electrical energy. Whether or not this is an important matter cannot be stated now. The state of our knowledge on economc feasibility is not such that the feasibility depends on a little higher thermal efficiency.

Shielding

Shielding for the reactor of a central station power plant is not a question of major significance. Ordinary concrete of sufficient thickness will do the job. The magnitude of the radioactivity in the circulating cooling system is not to be underestimated. Both the watercooled and sodium-cooled reactors, for instance, require heavy shielding around the cooling pipes exterior to the reactor. In the case of sodium cooling, approximately five feet, and in the case of water cooling, three feet of concrete are required. What must be noted, however, is that the cost of the shielding where concrete can be used is not an important item.

The picture of the power reactor which the foregoing discussion has no doubt created is a structure containing moderating material and rods or pipes carrying uranium cooled by water or sodium. Curiously enough, the only reactors which so far have produced any amounts of electrical power do not fit into this description. The first reactor to produce electricity, the Argonne National Laboratory's Experimental Breeder Reactor, operates on fast neutrons and thus does not require a moderator. The homogeneous reactor experiment, which Oak Ridge National Laboratory recently announced has generated some electricity, is moderated but contains no solid uranium pieces.

A Date to Remember

Aug. 15

At Chevy Chase Country Club

WSE'S 4th Annual Golf Tournament

(Details on Page 2)

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The Experimental Breeder Reactor

The Experimental Breeder Reactor uses as materials of construction only metals and is cooled by a liquid metal, an alloy of sodium with potassium. The temperature of the issuing coolant is 660°F which is adequate to generate 400 psi steam with a considerable amount of superheat. As the name for this Reactor suggests, its main purpose is to explore the possibility of achieving a high conversion ratio of uranium to plutonium or plutonium to plutonium. Maintaining the chain reaction with fast neutrons gives an excellent chance for the so-called nonfissionable U238 as well as U235 to be fissioned and to contribute neutrons to the chain reaction. This "fast effect," which is a bonus for the conversion ratio, is also present in the moderated neutron reactors but to a lesser extent depending on the thickness of the uranium pieces used. This experimental reactor has been operating for more than a year without serious difficulty and regularly produces electrical power sufficient to support the laboratory in which it is housed. Thermal neutron reactors have been operated reliably for many years and it is gratifying to find that the fast neutron breeder reactor is having the same experience.

The Homogeneous Reactor

The homogeneous type of reactor, which essentially is a vessel containing a solution of fissionable fuel in a moderating liquid, is important because it eliminates many of the problems associated with radiation damage of the solid fuel. It also has the obvious advantage that the fuel of the reactor can be gotten in and out through piping rather than requiring the mechanical handling which is a characteristic of the solid fuel reactors. An additional advantage is the possibility of having the fuel solution flow directly to a chemical processing operation in order to remove fission products. With these advantages come certain disadvantages. The solution containing the fuel must be pumped through heat exchangers outside of the reactor vessel. Since now all of the fuel passes through the heat exchangers, they become highly contaminated with radioactive fission products. Therefore, one of the most serious problems with the homogeneous reactor is the construction of a cooling system of extremely high integrity, since maintenance will be very difficult and probably must be done by remote control. It should also be noted that in a homogeneous reactor, the bonus to the conversion ratio due to the "fast effect" fissioning of U238 will be zero.

Reactor Location

The question of economic feasibility is specifically involved in the location of reactor plants. Several dozen reactors have been operating in the world for some little time. All of these contain within them sizeable amounts of radioactivity; for the large production type reactors operating at high power, it is a prodigious amount. No operating failure of these reactors has caused any hazard to the environs. On the basis of such experience, confidence is growing that reactor operation can be made as safe as other industrial operations. It is only fair, however, to point out that recently in releasing to farming the Wahluke Slope in the State of Washington, the Atomic Energy Commission announced that for safety reasons no towns or cities should be established within 25 miles of the Hanford reactor area. It qualified this statement with the further observation that the Hanford reactors are unique in design and that for other reactors, the hazard is not so great. We can expect that an expanding military use of reactors and the beginning of a nuclear power industry will lead to the development of types of reactors and techniques which will limit and minimize the so-called hazard. It is not expected that central station power reactors can or should be burdened indefinitely by the expense of remote location.

To sum up this resume of reactor types, it is fair to say that no one type has all the desirable features and no disadvantages. Only experience will bring about the evolution of the most successful reactor system. There are at least three or four systems which technically appear adequate and which ultimately can lead to high performance competitive plants. Choosing the one or two "best" systems to concentrate on now is much less important than making the decision to go ahead and develop and build and operate a nuclear central station power plant. No one can foresee that a particular reactor system, chosen on an evaluation of facts as we know them now, will be the system of the future. Advantage will swing from one type to another as new discoveries are made.

Reactor Power and Economic Feasibility

There is one aspect of the power reactor question which does require careful consideration at this time—that is, the power rating of the reactor plant. Small reactors of from one to fifty MW of heat are extremely useful for proving out various phases of technical feasibility. More such experimental units are highly desirable. To get experience figures on economic feasibility requires that the test plants be of a rating comparable to present day coal-burning plants. Electricity generated in small plants will be uneconomic and, with no experience for guidance, extrapolating to get the cost of power for a large installation is an impossible task. Any plan to test the performance of the nuclear reactor as a competitive power source should envisage the construction of a plant of substantial size; 75 MW to 200 MW electrical capability is suggested as the useful range.

(Continued on Page 14)

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The Whole Loop at its Doorstep

(Continued from Page 13)

Granting that there are sound grounds for believing that, technically and economically, atomic power is possible there remains a question which has been asked by some scientists and some officers of our government. The question is, "What reasons are there which call for this country to devote any of its money or technical talent to the development of central station atomic power?" My answer can be summed up in these three statements:

First, the United States has led the rest of the world in the development of atomic energy as a military weapon. It has unparalleled resources of technically trained manpower and specialized equipment. In the light of this, does it make sense, and do the American people want, to *willfully refuse to make* the additional effort required to realize from atomic energy its major peaceful use? I think the answer is no.

Second, the atomic bomb and other nuclear devices play a leading, if not overwhelming, role in the defense planning of this country. Even an infant nuclear power industry would broaden the base of technically trained manpower on which our atomic superiority in considerable measure depends, and it would increase and disperse facilities which could be converted to support our atomic arms.

Third, and most important, the fossil fuel resources of this continent and the world are not inexhaustible. Neither are fissionable materials inexhaustible, but they can provide substantial amounts of power, in terms of the world use of power, for a considerable time and thus help bridge the period between the petering out of fossil fuels and the successful use of solar energy or some other permanent source of energy.

Information forums can be extremely helpful. Informed public opinion, I am confident, will approve the efforts of our representatives in Congress in making changes in the Atomic Energy Act, if these are needed, and will approve the efforts of the Atomic Energy Commission in formulating and backing proposals to put the atom to work. Bold determination to reap the benefits of a new invention while guided by experience has been a successful formula in the past. We have every reason to expect it to succeed in atomic energy.

Build World's Largest Generator

The world's largest and most powerful turbine-generator, which Westinghouse Electric Corporation will build for Detroit Edison Company, will be as big as two six-room homes and will consume 15 times its own weight in steam every 24 hours, it was revealed May 28 in Philadelphia.

Ray H. Timmons, manager of the Westinghouse Steam Division there, said the giant 260,000 kilowatt unit recently ordered will weigh over 1,300 tons and will be one of two similar machines to be installed in Detroit Edison's new River Rouge generating station at the junction of the Detroit and Rouge Rivers. The unit will have a power output of some 350,000 horsepower.

Valued at $6,000,000, this Goliath of turbine-generators is sufficiently powerful by itself to supply the electrical needs of a city the size of Seattle, Wash.; Cincinnati, O.; Dallas, Tex.; or Minneapolis, Minn., Mr. Timmons said.

"This new turbine-generator will consume about 800 tons of steam every hour of the day while operating at full speed," Mr. Timmons declared. "In a 24-hour period, it would consume 19,000 tons of steam or nearly 15 times its own weight."

The Westinghouse executive said the turbine part of the unit will be constructed at the company's Steam Division plant in South Philadelphia and the generator will be built at the East Pittsburgh, Pa., plant. He said the unit is scheduled for delivery early in 1956 and that it will be "in service" by late 1956.

Mr. Timmons pointed out that the Detroit Edison unit will surpass any of its predecessors in both physical size and rating. The new unit will stand about two stories high and will occupy a space about 85 feet long and 70 feet wide.

The steam turbine that will drive the generator will utilize steam fed to it at 2,000 pounds per square inch at a temperature of 1050 degrees Fahrenheit. The tip speed of the longest row of turbine blades will be over 850 miles per hour.

Navy's New Carriers To Be Air Conditioned

Both of the Navy's new aircraft carriers, the U.S.S. Forrestal and the U.S.S. Saratoga, will be air conditioned.

Carrier Corporation, oldest and largest U. S. air conditioning specialists, announced that they have been awarded the contract for the second of the two—the U.S.S. Saratoga. The U. S. S. Forrestal contract was awarded the same firm several months ago.

Six centrifugal cooling machines will be installed in each of the carriers to handle the air conditioning, and seven reciprocating units will take care of ships' stores refrigeration and the cooling of drinking water.

The twin carriers will be the largest fighting ships ever built.

Carrier Corporation pioneered modern air conditioning and has installed some of the biggest cooling systems in the country, including those in the Pentagon in Washington, D. C., and the United Nations Secretariat in New York City. It also is the leader in the sale of residential units for the complete year-around air conditioning of homes.

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Prospective Employer

(Continued from Page 8)

steps in one's life; therefore, adequate preparation is advisable.

The engineer may not be queried about all of these points, but to present his qualifications properly, he should be prepared to discuss them:

1. Type of work done in the past. Depending upon his interest and enthusiasm, the engineer has an opportunity to expand this phase of the interview. He can tell of some of the materials and equipment he used and if these presented special problems, how these problems were overcome.

2. Does he have a "machine sense?" Can he actually do the work himself? One employer stated: "We are looking for someone who can do the work himself and not one who can tell us how to do it. In other words, we expect him to be an engineer who can carry out his own ideas in an experimental way."

3. What has he designed?

4. Does he know specifically what he wants to do in the engineering line? For example, would he like to get into the production end of the business? If so, why? Perhaps his work in the past indicates that he gets along with people, that he is a leader, that he inspires others to do their best. An industrial engineer who had ideas along this line was accepted for a position as Production Control Manager. The president of the company made this comment about the engineer: "we feel he is exactly the man we have been seeking. It will interest you to know that he has been chosen from more than 20 applicants."

5. If he is considering a change from one type of industry to another, why does he think he can do the new work? For example, he may never have been affiliated with a printing company, but in high school printing machinery had fascinated him. He finds himself attracted to printing equipment when he visits a printer to place an order. Recently he has been reading printing trade journals, etc.

6. Does he have helpful ideas? Perhaps he can give examples of ideas he developed for his previous employers. He may even be at liberty to quote savings.

7. Some idea of the size of the organizations with whom he was previously connected. Executives of small plants usually welcome the engineer who has worked for a large company. Such an engineer's standards are usually higher. He has probably worked with a greater variety of equipment, and he knows what the production of poor equipment is compared to that from good equipment. He generally has seen more operations and has a wider perspective.

8. Long range viewpoint. Does he have ambitions to move up? Would he only be happy if he remained in a particular line of work? This is the time to reveal the completion of supplementary courses in subjects such as human relations, rapid reading, or conference leadership techniques.

9. Ability to write. Mention articles or manuals that he has written. Remembering the quotation: "an engineer has more to tell than anyone, and tells it the poorest," the engineer with writing ability can stress his achievements in this line. In organizations where much of the transactions and activities are carried through in writing, this is a selling point.

10. Personal background. This includes education, family, community activities, hobbies and similar related details.

Now the brochure

The detailed brochure is the final step in the presentation of an engineer's qualifications. It is literally an autobiography, designed to support the statements made in the interview. As such it should be handed to the prospective employer just before leaving. It helps the employer review the interview. Exhibits such as blue prints of the engineer's designs, reproductions of published writings, and reproductions of special commendations permit the employer to see for himself what the engineer has done.

The vice president of a prosperous company in Chicago started in the concern as an engineer. During his employment as an engineer he began to develop his brochure. He had photographs and sketches made of all equipment that he designed or improved upon. When he received a bonus check and a letter thanking him for a particular development, he reproduced the letter. It has not been necessary for him to use the brochure for a new affiliation because he was promoted to the vice presidency. But he did comment that the brochure helped sell the idea of his worth to the officers of the company and was a deciding factor in his promotion.

An important reason for making the detailed brochure the final step rather than the first approach is to avoid the situation where the engineer tells everything about himself in the brochure and has nothing more to say when called in for the interview.

It makes a difference when the engineer can present his qualifications properly. In most cases such engineers have made better use of their skills, they are happier in their new employment, and in a number of instances they have doubled their previous salary.

Robert Moses to Keynote Michigan Centennial Meet

Robert Moses, New York City's commissioner of parks, will be a featured speaker at the University of Michigan's Engineering Centennial next October it was announced at Ann Arbor.

George Granger Brown, dean of the College of Engineering, said that Moses would speak on "The Contribution of Modern Engineering to Our Civilization" at a banquet Friday evening, October 23, the first day of the celebration.

Moses recently won $25,000 in a General Motors contest with his plan for improving the nation's highways.

The dean also reported that Harvey M. Merker, consultant for Parke, Davis & Company and a Michigan alumnus, would report on 100 years of engineering education at the University on October 24.

The Saturday afternoon program will be devoted to "The Campus of the Future," with the dedication of the new Mortimer E. Cooley Memorial Laboratory and visits to the new 347-acre North Campus.

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Faith of the Engineer

I AM AN ENGINEER. *In my profession I take deep pride, but without vainglory; to it I owe solemn obligations that I am eager to fulfill.*

As an Engineer, I will participate in none but honest enterprise. To him that has engaged my services, as employer or client, I will give the utmost of performance and fidelity.

When needed, my skill and knowledge shall be given without reservation for the public good. From special capacity springs the obligation to use it well in the service of humanity; and I accept the challenge that this implies.

Jealous of the high repute of my calling, I will strive to protect the interests and the good name of any engineer that I know to be deserving; but I will not shrink, should duty dictate, from disclosing the truth regarding anyone that, by unscrupulous act, has shown himself unworthy of the profession.

Since the Age of Stone, human progress has been conditioned by the genius of my professional forbears. By them have been rendered usable to mankind Nature's vast resources of material and energy. By them have been vitalized and turned to practical account the principles of science and the revelations of technology. Except for this heritage of accumulated experience, my efforts would be feeble. I dedicate myself to the dissemination of engineering knowledge, and, especially, to the instruction of younger members of my profession in all its arts and traditions.

To my fellows I pledge, in the same full measure I ask of them, integrity and fair dealing, tolerance and respect, and devotion to the standards and the dignity of our profession; with the consciousness, always, that our special expertness carries with it the obligation to serve humanity with complete sincerity.

Illinois Bell Telephone Is 75

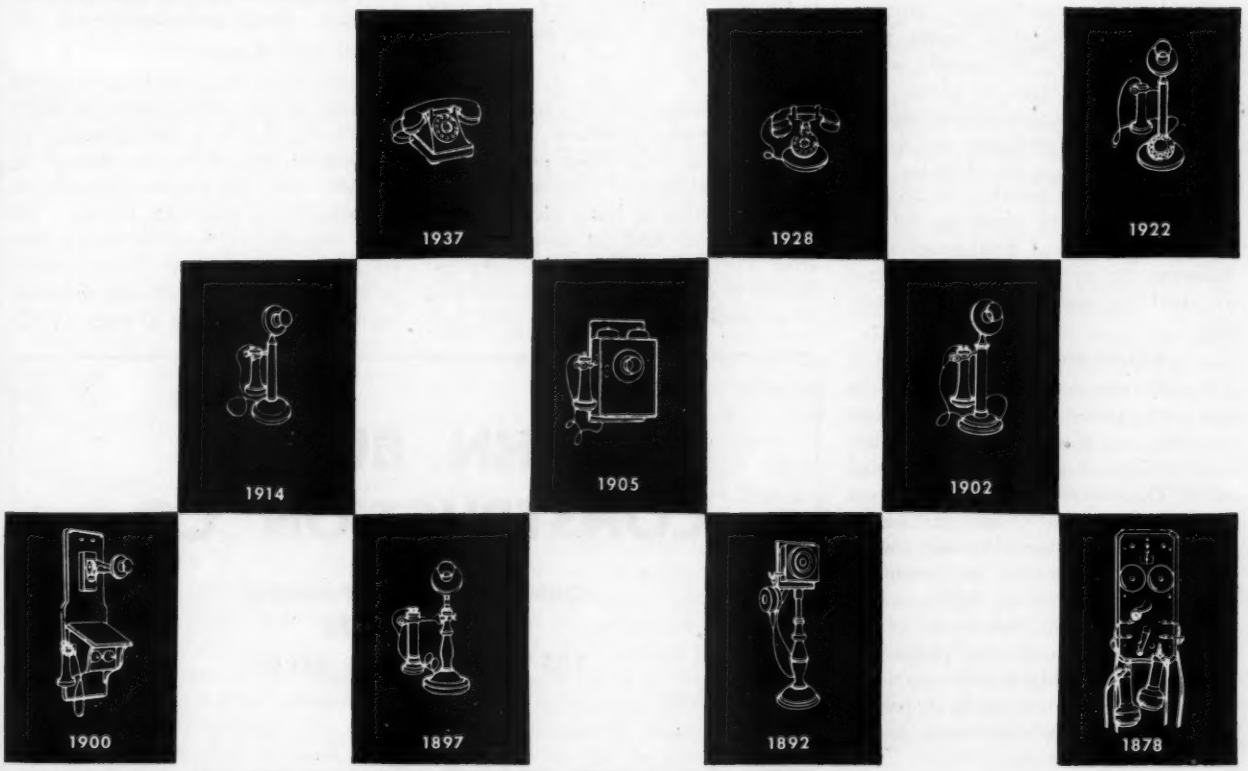
The Western Society of Engineers and the Illinois Bell Telephone Company have grown up together. The Western Society was born in 1869 as the Civil Engineers Club of the Northwest. A short eight years later the telephone arrived in Chicago and Illinois. In the time since these two precocious youngsters were born, both have grown strong, and both are still expanding.

The Western Society celebrated its 75th anniversary in 1944. This year Illinois Bell is taking its turn in celebrating a diamond jubilee. Among WSE members who are marking the occasion are Bill Kahler, a past president of WSE and president of Illinois Bell, and over 230 other Illinois Bell Telephone Company employees. Of course, the Western Society's full membership wishes this outstanding company increasing prosperity and continued success.

The American District Telegraph Company opened the first telephone exchange in Chicago on June 18, 1878. The Bell exchange opened for business on the 26th of the same month. Three years later in 1881 the two companies consolidated, forming the Chicago Telephone Company, the predecessor of Illinois Bell Telephone Company.

Compared with that of today, Chicago's telephone service during the first few years was primitive indeed. In 1878 a person had to follow a rather involved set of instructions and use the services of as many as five people in making an intracity call. Often as many minutes were expended in getting through a call as we spend in seconds today. What a difference!

The improvement in telephone design is as marked as the improvement in service. Pictured for you in this article are a number of telephone styles and the year in which they were introduced. We can see that today's model is highly developed compared with those of yesterday. Today's model seems as polished, dignified and modern as the diamond, the gem representing the anniversary which Illinois Bell is celebrating.



Human Relations

(Continued from Page 9)

fall. If frustration has occurred it should be relieved without undue delay. The solution usually is quite difficult. It requires careful analysis and handling.

Attitude

A third factor which influences the individual's interpretation of a situation is his attitude. This is defined as a readiness to react in a characteristic manner to a given situation. Attitudes may be described as mental habits which can be broadly compared to physical habits. They act as frames of reference or windows through which we see the situation. These windows limit a full view of the whole situation. Attitudes may be favorable or unfavorable and they vary in intensity, with the extremes being called biases or prejudices.

Attitudes develop from experiences. They may result from the cumulative effect of a series of minor experiences or may result from a single forceful or emotional one. The people who survived the Haber Corporation fire in Chicago could have a very fixed attitude as a result of that one experience.

People adopt ready-made attitudes from others. Youngsters accept them from their parents. We usually accept the attitudes of people we admire.

Several other factors which influence the formation of attitudes are a person's education, age, mood at the time of an experience, position in life, the part of the country where he did live or now resides and first impressions. Attitudes can be developed or changed by providing new experience or education.

Ability and Personality

People also have different abilities and personalities which also affect the way they see a given situation. They vary in physical traits such as size and build. There are differences in senses. For instances some people can see or hear better than others. The motor abilities of coordination of movement or finger dexterity vary in different individuals. Mental abilities such as the ability to learn, memorize, judge and reason when combined make up intelligence which is not equal in all people. As for personality differences, let us talk about that later.

If we should take a large unselected group of people and should chart their abilities, we would find a rather uniform curve with a small number of people with very low ability and also about a like number with very high ability. The center of the curve would be humped like the back of a dromedary camel. In the center would be the greatest number of people. They have average ability. The curve would slope off in both directions. The people at the low end of the curve may have only one twenty-fifth the ability of those at the opposite end.

Extremes of ability in a group usually causes unhappiness. Employment people have recognized this fact and therefore set minimum employment standards which screen out those at the low end. People with extremely high ability tend to move on to other jobs which narrows the range of the group still left. Those in the lower ability bracket can be improved by training. Those at the top of the bracket tend to drop back so that the group stabilizes with the top producer turning out about twice as much as the poorest. A greater ratio is usually an invitation for trouble. The overall production of the group can be improved principally by further training of the poorer producers and motivating the good ones to do even better.

Now let us go back to personality which is not quite the same thing as character. Someone once defined character as being what a person really is but personality as what other people think he is. The victims of a confidence man at first feel that he has a nice personality. Later they find out about his character. Personality is becoming very important in the selection of personnel and in promotions. People with poor personalities can cause a lot of discontent among the force.

The Situation

We have been dealing mostly with the individual. Now suppose we give more attention to the situation. Usually people are members of groups. All members are not equally popular. In a group we will normally find a natural leader—not necessarily the formally designated leader—small sub-groups and perhaps one or more isolates. Most supervisors tend to feel sorry for an isolated person and try to get him accepted by the group. That is fine if he wants that status, but the supervisor can make a mistake if the isolate is such by his own choice. We are told that Steinmetz was a good example of an isolate by choice.

A group exercises considerable pressure upon an individual either by what the members do or say or by what the individual assumes they may think, do, or say. That is called group pressure. As a rule people prefer to be members of a cooperative rather than a conflict group. Communications—keeping people well informed of policy, facts, etc. —is an effective aid in building cooperation. The supervisor has a major influence on the kind of group he has, that is, whether it cooperates or not.

Leadership

Another very important factor in the situation which affects an individual's behavior is the kind of leadership he experiences. Leadership is defined as the ability to get people to work cooperatively and efficiently toward a desired objective. It may be formal, that is, delegated at the time of promotion, or it may be earned, leadership acknowledged by the group out of respect. It is

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better if the leader has the earned leadership prior to his promotion.

There are three kinds of leadership: authoritarian, laissez-faire and democratic. The authoritarian leader gives commands and exercises close control. The laissez-faire leader withdraws and provides very little leadership. The case referred to about the three teen-agers and the policeman may have resulted from this type of leadership by the girls' parents. The democratic leader brings in the group and consults it for ideas and possible solutions to problems. Participation in group solutions is the key to this type of leadership.

There is a time and place for all three kinds. The authoritarian type is effective in cases of emergency or when meeting deadlines. The laissez-faire type may be used to force an individual, who usually depends on others for solutions, to rely upon himself. It is also advised when an individual gets into minor trouble, in order to give him time to solve his problem and thus save face. The democratic type is most effective most of the time.

What is a good leader? Suppose we read the following:

"If all this is yours, you're a good foreman. Australians have been told that a good foreman must have the following qualities: initiative, dependability, cooperation, truthfulness, sincerity, tact, clean health habits, ability to mix, common sense, interest in other people, self-control, cheerfulness, patience, self-respect, clear diction, knowledge of workers' favorable responses, ability to express appreciation and give recognition, punctuality, and forcefulness."

How many of us would qualify as a supervisor if measured by these standards? How many items refer to technical knowhow? Now go back to the quote.

"These were listed by a visiting Canadian labor relations expert, Ray L. Hurd, manager of supervising training at Ford of Canada, Windsor, Ontario.

"He said 300 Canadian workers, in a poll, gave these points as necessary attributes in a good boss.

"Hurd added that 85 per cent of a foreman's job was human relations and 15 per cent was technical."

There is that human relations thing again. By now you have a good idea of what it is.

We have merely scratched the surface here. Condensing into a few words the material that requires at least 25 hours of classroom work with outside study and preparation is quite an inadequate coverage.

Engineers generally have a tendency to try to resolve problems to an exact science. When they cannot put 2 and 3 together to get 5, they tend to procrastinate in handling human behavior problems. It is perfectly understandable and reasonable that they should, for their formal education and their non-supervisory experience usually sets up such an attitude. When you consider all the variables in human relations you may realize why supervisors with an engineering background generally have difficulty in solving and handling behavior problems.

Because engineers will be playing a greater role in our society, it will be their duty and responsibility to learn more about the human side of the job. It will be in their interest to so behave that they will be a credit to the engineering profession. May they be worthy leaders in the growing electronic and atomic age that lies ahead.

To Conduct Research on Hot Box

Completion of two unusual testing machines for use in research on minimizing the occurrence of railroad freight car hot boxes was announced July 15 at Armour Research Foundation of Illinois Institute of Technology in Chicago.

O. E. Teichmann, associate manager of the Foundation's heat-power department, said the $275,000 project is one of the largest industrial programs the Foundation ever has undertaken.

The two-year project is sponsored by the Association of American Railroads.

The testing machines are:

1. An actual freight car truck—the assembly containing four wheels at the front or rear of a freight car—is set up so that cooling, heat flow, and temperature characteristics of the journal can be studied under controlled laboratory conditions. This is the only device of its type in existence.

Foundation scientists plan to study how the bearing is cooled and how the cooling action may be improved.

2. A full-scale bearing testing machine, which simulates the workings inside a journal box under controlled laboratory conditions, has been constructed.

The tester will be used in measuring frictional resistance of the bearing, fluid pressures, effects of different oils, and characteristics of waste materials used in lubrication.

The truck set-up and the bearing tester were built especially for this project in the Foundation's machine shop.

In explaining the overall hot box project, George L. Pigman, project engineer, said, "The journal bearing is a wonderfully simple device for keeping the wheels of a freight car moving.

"A survey showed that hot boxes occurred on an average of one for every 331,192 car miles in March, 1953. That means an imaginary car could have traveled around the earth more than 13 times before developing a hot box.

"The trouble is, hot boxes do develop, and it always means expensive delays and repairs."

The journal is the part of a freight car axle that supports the bearing. There are no moving parts in the bearing assembly, except for the rotating journal. An oil wick system feeds lubricating oil to the journal. When the car is in motion, oil is carried up to surround the journal.

Thus, the journal and bearing do not come into actual contact while the car is in motion. In effect, Pigman said, the freight car rides on a thin layer of oil.

Hot boxes may start when the metal in the journal and in the bearing come into contact while the train is moving, he explained. Heat generated by the friction raises the temperature and can ignite the lubricating oil. If the train keeps moving, the heat grows more intense.

Part of the bearing may melt, Pigman went on. The journal then comes into contact with a brass part of the bearing. As the temperature mounts, the rotating journal destroys the brass bearing.

A dozen scientists and engineers from the Foundation's heat-power, chemistry, metals, dynamics, electrical engineering,

(Continued on Page 20)

(Continued from Page 19)

and operations research departments worked on the initial phase of the project, a field survey of railroads and related facilities to provide information and a practical knowledge of operating conditions.

Here are some facts the researchers found during the field survey:

—Performance of journal bearings is considerably better in the fall and spring than during the summer.

—More stringent inspection, maintenance, and repair will reduce hot boxes.

—Use of new oil additives may help overcome some lubrication faults. This is being studied.

—Hot boxes occur most frequently on open-top cars, such as gondolas and hopper cars. Normal usage of these cars involves a higher average load than that for box cars.

Pigman said the purpose of the current phase of research is to learn basic principles involved in bearing operation, limitations of present bearing design features and materials, and practical means for improving performance.

He said the research group also is trying to determine whether a hot box detector is feasible without requiring installations on the cars.

Salvage and Move Pit, Make Saving of $8,000

Salvaging and moving a concrete pit may sound like unnecessary work to the uninitiate but it meant a saving of $8,000 for a steel company in California, *Construction Methods and Equipment*, McGrew-Hill publication, reports.

Under an expansion program, one of the pits in which new refractory linings are put on the huge ladles that carry molten steel from the open hearths was to be abandoned and a new one built in another location.

Rather than scrap the old pit, actually a large concrete box set in the ground, it was lifted by crane and set into a new hole excavated for the purpose, the magazine says. A 250-ton overhead crane was used and two holes were driven through each of two opposite sides of the pit to receive the lifting cables for the crane hooks. Two heavy timbers, spanning the pit between the two lifting walls, gave extra stiffening at stress points as the cables tightened.

To Open Equipment Study Center

A national center to conduct education and research in the methods of industrial equipment acquisition and replacement will be established this fall in the department of business and economics at Illinois Institute of Technology.

Plans for the proposed center were announced recently by William J. Kelly and Dr. John T. Rettaliata, MWSE, presidents of the two sponsoring organizations, the Machinery and Allied Products Institute and Illinois Institute of Technology, respectively.

The center, to be known as the National Center of Education and Research in Dynamic Equipment Policy, will be housed in one of the modern new buildings on I.I.T's 110-acre campus on Chicago's Near South Side.

The Machinery and Allied Products Institute will finance the center during its initial years.

In announcing the establishment of the Dynamic Equipment Policy Center, Rettaliata and Kelly explained the need for such an educational-research program:

"A scientific approach to the acquisition of new equipment and replacement of worn-out or obsolete equipment is of prime importance to the success of every business enterprise," they said.

"The general application of sound equipment policies is also basic to the continued industrial leadership of the United States, and is inextricably bound into our national security. Thus, a better understanding of the techniques and applications of equipment policy at one and the same time serves private enterprise and fulfills a compelling public interest."

The center will have two basic objectives: (1) The wide dissemination of information as to enlightened equipment policy; and (2) Sustained study of improved techniques and continued analysis of the problems and practices of business in this field.

To implement these objectives, Dr. Pearce Davis, chairman of the I. I. T. department of business and economics, outlined the following program for the center:

—New and revised courses of instruction in Dynamic Equipment Policy will be introduced both at the graduate and the general education levels.

—Lectureships in Dynamic Equipment Policy will be established. Lecturers will be appointed by I.I.T. and will be responsible for teaching day and evening session courses at the center.

—Regular summer seminars and conferences for concentrated study of equipment analysis and replacement methods will be offered to industrial and business executives.

—Graduate fellowships will be established, the recipients to specialize in Dynamic Equipment Policy.

—National awards will be given for the best essays in the field of Dynamic Equipment Policy.

—Staff members and students at the National Center will conduct research in the application of Dynamic Equipment Policy.

—A research library in Dynamic Equipment Policy will be established at the center.

Illinois Institute of Technology will name a director to head the new center. He is expected to be chosen in the near future.

An advisory committee will be appointed by the Machinery and Allied Products Institute to cooperate with the director and with Illinois Tech in the execution of the center's program. Dr. Rettaliata and Dr. Davis will be members of this committee.

The Dynamic Equipment Policy Center, Dr. Rettaliata explainded, represents another major addition to Illinois Tech's already extensive program of management education.

"It is," he said, "the outgrowth of pioneering work done by the I.I.T. department of business and economics in the field of engineering economics and capital equipment policy. The establishment of this center at Illinois Tech affords a unique opportunity for I.I.T. to extend its services to industry in a field vital to our national economy."

The WSE Bar **will remain open all through the summer. Come in, relax, and enjoy yourself.**

Air Pollution War Pays Dividends

The successful war on air pollution is resulting in easier air conditioning, from the architect's standpoint. Cleaner incoming air, due to improved methods of purification, means that only enough outdoor air is now needed to avoid objectionable carbon-dioxide concentration. The result will be reduced sizes of boilers, refrigerating equipment and ductwork.

This was brought out by Norman Sharpe, head of the Air Conditioning and Refrigeration Department, California State Polytechnic College, San Luis Obispo, California, at the semi-annual meeting of The American Society of Mechanical Engineers in the Hotel Statler in Los Angeles on June 29.

Suitable ways have been devised for removing nearly all objectionable pollens, smoke and atmospheric dusts with accompanying bacteria and odors. Improved dry filters, electronic precipitators, and activated carbon absorbers play important parts in complete air purification, he said.

Using purified recirculated air rather than outdoor air for ventilation not only eliminates the non-recoverable loss of cooling the outdoor air to the room condition, but also enables the engineer to design the system for maintaining lower relative humidity in the rooms, with consequently smaller quantities of air and smaller-sized ducts to bring it in.

Studies of ventilation for inhabited rooms have disclosed that in the ordinary quiet respiration of human beings no volatile poisonous matter is in the expired air, other than carbon dioxide. The air expired from the lungs has no odor. Bad breath is caused by unclean mouth and teeth conditions. Odor, mainly body odor, has considerable effect on comfort and people in the room.

The air in an occupied room is contaminated by many sources besides the expired air of occupants. These contaminants are in the form of minute particles of dust. Tests in a hospital room showed that in this dust (which could be removed by a filter) there were microorganisms, including some of the bacteria which produce inflammation.

The concentration of carbon dioxide and diminution of oxygen, found in crowded, poorly ventilated churches, schools, theatres and barracks, is not great enough to account for the discomfort produced in many persons. Neither is such discomfort caused by bacteria nor, usually, dusts of any kind. The main causes are excessive temperature, humidity and unpleasant odors.

In most buildings the normal infiltration leakage of air provides enough oxygen to keep the carbon dioxide concentration at a sufficiently low level. In tightly insulated buildings two cubic feet per minute of outside air per person, depending on their activity, is sufficient.

Tobacco smoke presents a greater problem than body odor. About 25 cubic feet of outside air per minute per person is required where smoking is allowed, while 12 may be enough to control body odor in ventilation.

The effect of air pollution on the general health of the people in industrial districts is largely a matter of speculation. Pollutants vary from time to time in a given community. Normally the atmosphere does not become sufficiently polluted to cause distress, but in foggy weather, during periods of low air velocity, or during periods of temperature inversion in the atmosphere, the accumulation may become so great as to cause irritation of the eyes or respiratory passages and even death to those afflicted with respiratory or heart ailments.

Purity of indoor air is maintained by removing the pollutant at its source and by diluting the indoor air with cleaned outdoor or recirculated air. Usually a combination of devices such as filters, electronic precipitators, adsorbers and air washes are needed for good air purification.

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Civil Engineering Students Take to Wisconsin Woods

Illinois Institute of Technology civil engineering students—armed with transits, note pads, and fishing gear—took to the Wisconsin woods for the summer it was announced in Chicago.

Main purpose of the trip is a field course in surveying offered each summer at Camp Armour, located on Trout lake about 400 miles north of Chicago.

The area is also noted for its well-stocked lakes, pleasant summer climate, and good swimming, and boating.

This is how Benjamin A. Wasil, MWSE, assistant professor of civil engineering, described a student's typical day:

Up early in the morning, hearty breakfast, surveying, lunch, more surveying, dinner, and then recreation.

The course calls for a five-and-a-half day, 44-hour work week, he said. For some students, the course runs eight weeks, and for others, five. The subject is required of all Illinois Tech civil engineers.

Wasil explained that Illinois Tech has been leasing the camp from the state of Wisconsin through the years. "We've been making improvements since the camp was founded in 1914," he said, "so that it has remained pleasantly rustic, with enough modern conveniences to make life comfortable."

The entire area surrounding the camp is available for topographic and route surveying, Wasil went on.

Dr. Ernest Masur, associate professor of civil engineering, heads the camp.

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PMI Okehs New Departments

Immediate establishment of a technical and engineering department for the Pressed Metal Institute was approved by PMI's Board of Directors in a three-day Spring executive session concluded recently at Congress Lake Country Club in Hartville, Ohio. The department will be headed by a full time technical director attached to the staff at PMI's headquarters at 2860 East 130th Street, Cleveland, Ohio. This department will function as soon as a qualified engineer has been located by PMI's Technical Research and Standards Committee.

This expansion is the culmination of a five year tangible service program for Pressed Metal Institute members started in March, 1949 and keeps the program on schedule. It also represents the largest single appropriation for improved membership service, since the first Pressed Metal Institute was founded in 1918.

Expanded technical services to members have been under study for some time and the Board's action was finally determined by an industry survey conducted by Armour Research Foundation of the Illinois Institute of Technology which proved technical programs are considered PMI's most valuable service and would secure 100% membership support. This survey also indicated these services could be received through PMI at a fraction of the cost to an individual member.

This department will study those technical trends having a far reaching affect on the industry; will provide liaison with other technical committees and the government; advise of technical advances in competing industries; publish a monthly technical bulletin; compile a handbook for the industry; and extend cooperation to engineering colleges.

It is anticipated that original research will eventually become a part of this program. Among items being considered, both from the standpoint of collating present known information and experimenting with information not now available, are the problems of metal flow, wrinkling, spring back, and die design in relation to metal flow. Similar problems will in turn be evaluated by the technical director and PMI's Technical Research and Standards Committee.

Other problems investigated by the appropriate executive committees during the three-day session at Congress Lake included liaison with engineering colleges and universities in an enlarged program of information on metal stamping for the benefit of students, including recommended curricula brought up to date for current use. Cooperative advertising on behalf of members; an enlarged annual technical meeting with exhibits; and more basic research in marketing and original statistics were also discussed and programmed by these executive committees.

President of the Institute is Wallace F. Ardussi of the Variety Machine & Stamping Company, Cleveland, Ohio. Vice president is Samuel P. Hull of the Worcester Stamped Metal Company, Worcester, Massachusetts and treasurer of the Institute is Hunter Morrison, Jr., of Morrison Products, Inc., Cleveland, Ohio. Staff headquarters are at 2860 East 130th Street, Cleveland, Ohio. Orrin B. Werntz is managing director and E. M. Ross is assistant manager.

World's Astronomers to Gather September 3

Approximately 30 of the world's top astronomers will gather in Evanston next fall for an international conference on astronomy, sponsored jointly by the National Science foundation and Northwestern University, according to Dr. Kaj A. Strand, director of the University's Dearborn Observatory.

The conference, to be held Sept. 3-5, will deal with the coordination of research on such subjects as the determinations of the positions, motions, and distances of the stars, which have important bearings on the structure of the Milky Way system.

Among the astronomers expected to attend the conference are Sir Harold Spencer Jones, astronomer royal of Great Britain; Prof. Otto H. L. Heckmann, director of the Hamburg Observatory in Germany; Prof. Andre Danjon, director of the National Observatory in Paris; Dr. Anton H. Blaauw, from the Leiden Observatory in the Netherlands, and Dr. R. H. Stoy, Her Majesty's astronomer at the Cape, South Africa.

Obert of Northwestern Wins ASME Award

Edward F. Obert, Northwestern University professor of mechanical engineering, on June 25 received the eighth annual George Westinghouse award in engineering education at the annual banquet of the American Society for Engineering Education held at the University of Florida, Gainesville.

The award, sponsored by the Westinghouse Education foundation, is made to the outstanding engineering teacher in the United States and Canada under the age of 45. It was established to encourage younger men who show evidence of continuing activity as superior teachers and who are carrying on projects for the improvement of teaching in engineering.

Obert, a Northwestern faculty member since 1937, largely was rsponsible for the design and construction of the heat power laboratories at the University's Technological Institute, and has been director of the laboratories since they were opened in 1941.

A specialist in internal combustion engines and thermodynamics, he has been noted for his unique instruction methods which have been followed by many of the institute's instructors who received their training under Obert.

He holds two degrees from Northwestern and received his master's degree from the University of Michigan in 1940. From 1929 to 1930 he was an engineer in the department of manufacturing difficulties of the Western Electric Company, and he served from 1934 to 1937 as engineer of naval materials for the federal government.

Obert's books, which have been adopted widely by teachers in mechanical engineering, include *Internal Combustion Engines, Thermodynamics,* and *Elements of Thermodynamics and Heat Transfer.* Obert also has done research and published papers in the fields of thermodynamics, combustion engines, and machine design.

Recently elected chairman of the Chicago section of the American Society of Mechanical Engineers, he is a member of the ethical standards and visual aids committees of the American Society for Engineering Education and belongs to several engineering fraternities.

On Training—

Letters from Leaders

In the last issue of Midwest Engineer we published another of about thirty letters received from leaders of Chicago-area firms concerning shortcomings noted in the engineers in their employ. Many of the letters also suggested what the engineers should do to correct their deficiencies.

Significantly, the engineer's technical training is generally considered adequate. In the broad area of Human Relations, however, engineers seem often to be "under achievers," according to the viewpoint of the industrial leaders as reflected in their letters.

We are printing another of these letters in this issue, as we shall do in future issues. Although the letters may be of greatest value to the younger engineers, we hope that all of the engineers who read them will benefit.

Here, then, is the next letter:

Dear Mr. Becker:

Your letter of August 31, addressed to Mr. ..... has been referred to me. The subject you raised vitally concerns the whole engineering profession, and I am pleased to learn that you are continuing your efforts in this area of engineering training.

I assure you of our interest in your project and of our desire to assist you in any way possible. The development of engineers for management as well as for technical positions is a field to which ..... has given considerable attention, both in the development of educational and training programs within the company, and in our programs with colleges of engineering and business administration. My comments will, therefore, be based largely upon our experience.

Dealing as it does with human relations, the problem you are tackling is at once intriguing and at the same time the most complex problem facing industrial management. Assuming that a young engineer has sufficient technical knowledge to grasp the engineering and scientific aspects of the situations which normally come up, the major task of grooming him for management is in the realm of the social sciences and the humanities. All too frequently, management skills are thought of as something the individual was born with, or something he should have acquired in college, or possibly picked up in a short course on effective development, rather than as a process of life-long learning. The problem is complex because it involves not only the individual's experiences during his practice in industry and in college, but also his experiences in the secondary schools and early family life.

In your letter you mentioned that among other approaches you are attempting to ascertain the viewpoint of industrial leaders on the deficiencies of engineers. Although such an approach will no doubt be helpful in your overall study, it is difficult to secure the specific information you need. The deficiencies of an individual can be observed and determined, but to determine the deficiencies of a professional group, especially when these shortcomings are of a non-technical nature, is hazardous indeed. For example, several personal qualities essential to a manager are adaptability, drive, capacity to deal with people, and a business sense. To say that engineers as a group lack these qualities would be missing the mark, as much as it is to say that doctors and lawyers have them. I think you will agree the qualities essential to a good manager vary more from individual to individual than from group to group.

In our company we encourage our young engineers to determine their individual deficiencies and develop a plan to overcome them. I can illustrate my point by this over simplification. Those who are weak in speaking and writing are encouraged to enroll in a business communications course, and those who are short on technical knowledge are encouraged to take part in our Graduate Study Program affiliated with a number of universities. The analysis, therefore, is on an individual rather than on a group basis. Accordingly, our solution to the problem is to provide our young engineers with various educational and training opportunities, and to encourage participation in those parts which benefit him most.

You have asked a question concerning the deficiencies of engineers, generally, and I shall attempt to answer it, although my answer will be in general terms. I should like to preface my remarks by saying that all factors considered, the colleges are doing a good job of preparing young engineers for industry. Emphasis on the teaching of fundamental principles and their application as opposed to teaching techniques has greatly increased the effectiveness of young engineers. The strengthening of the social-humanistic stem has materially broadened the young engineer's viewpoint. Moreover, companies in increasing numbers are devoting attention to the training and broad professional development of their technical personnel. Nevertheless, much remains to be done. Your study can accomplish a lot by focusing attention on this important problem.

In general I think the great majority of our managers feel that engineers are well prepared for engineering management from the standpoint of technical knowledge and engineering skills. Although the deficiencies of engineers are no greater than other professional groups, they are short on business knowledge, management techniques, and human relations skills. In most engineering problems, economic factors loom large in the final decision. In industry the engineer must be a business man as well as

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in the final decision. In industry the engineer must be a business man as well as a scientist. The trend toward specialization in industry has presented problems in developing men for management. The engineer who is highly specialized in one field has difficulty in striking a balance in dealing with the multitude of problems with which he is confronted, for he has a tendency to think along the lines of his own specialty.

Undoubtedly the area requiring the most urgent attention is that of human relations. This includes the whole field of leadership, human behavior, motivation, and dealing with the problems involving the interaction of people in groups. In discussing productivity, managers will invariably say the greatest problem is securing spontaneous cooperation and teamwork. The productivity of a department is closely related to the esprit de corps of the group which in turn reflects the social skills of the manager leader.

I think it is apparent that management development is a joint responsibility of the educational institutions, industry, and engineering societies. You are no doubt familiar with the ECPD study, "The First Five Years of Professional Development," which was conducted under the leadership of Mr. A. C. Monteith, and is available at ECPD headquarters.

In ..... we have taken a rather broad approach to the problem and we are attempting to raise the level of professional competence throughout our organization through a rather comprehensive program. We operate on the basis that the groundwork for management as well as technical development must be laid early in the young engineer's professional career.

Doubtless you will have occasion to be in the ..... area in the near future. If so, I will be pleased to discuss this subject with you.

Better Steels and Enamels Sought

Better steels and more durable enamel finishes for the many home uses from the kitchen to the laundry are the objectives of a new specialized research laboratory set up in Pittsburgh, Pa. by United States Steel Corporation.

The new laboratory is equipped to test new steels and surfaces for enameling, as well as to serve as a "torture chamber" to determine the degree of abuse the finished product can resist.

Porcelain finishes on steel are produced by fusing enamel to steel at a high temperature. Enameled steel sheets are used in the manufacture of refrigerators, washing machines, dryers, ironers and parts of a host of smaller kitchen and household equipment.

Since the major ingredient of porcelain enamel is glass—known in the trade as "frit"—the surface of the steel is really coated with a sheet of glass. The life of the surface, which means its neatness and beauty, as well as the utility of the appliance, depends on the structural strength of the steel and on how well steel accords with the special properties and strength of glass.

In the laboratory tests, many new and standard steels will be studied for their performance under high temperature, at levels required to bake the porcelain enamel coating permanently on steel. Called "sag testing," these studies will determine what steels are best for porcelain-enameled products and what heat treatments will give the best results in preparing steels for this finish. Specimens will be tested in the unenameled state so that the "sag" characteristics of the steel, rather than those of a combination of steel and enamel, can be studied.

To duplicate the surface treatments given steel by commercial enamelers and to study surface treatments to improve enamel adherence and other qualities, the new laboratory will also have a pickling department, with steam-heated coils and steam regulators for controlling the temperature of working solutions within 3° Fahrenheit. In addition to acid treatments, test panels of steel will also be prepared for enamel by blasting them with various rough materials like sand, carborundum, or metal shot.

In the enameling room, frits and pigments for coloring will be specially ground and mixed. A typical enamel may consist of various frits, silica, borax, clays, and sometimes other special ingredients, such as feldspar. The enamel is mixed with water and applied to the prepared steel surface by spraying or dipping. Then the test panels are dried and fixed in electric ovens as hot as 2,000° Fahrenheit.

Besides the processing equipment, the laboratory will have the latest physical-testing appliances. In this section, enameled samples will be subjected to severe twisting, bending, and pounding to make sure of the adherence of various porcelain coatings.

In addition to the facilities designed especially for enameling studies, there is available the complete round of other testing equipment of the research and development laboratory of United States Steel.

American Bar Center to Be Built by Turner

The American Bar Foundation announced recently the award of a contract to the Turner Construction Company for the construction of the new American Bar Center in Chicago.

Turner was the lowest of six bidders. The 3-story structure, with a floor area of approximately 63,000 square feet, to be erected on 60th Street between University and Woodlawn Avenues, opposite the University of Chicago Midway, will have a concrete frame, metal pan floor construction, with exterior walls of limestone, brick backup and aluminum sash.

Total cost of the building, including equipment, has been estimated at $2,000,000.

Actual construction was scheduled to begin July 15th and the new building is to be completed within a year. Tentative plans are to dedicate the Center in connection with the 1954 annual meeting of the American Bar Association to be held in Chicago. E. A. Courter, vice president of the Turner Company, in charge of its Chicago office, will direct the construction operations.

The American Bar Foundation which will erect and operate the building for the non-profit agency is presently carrying on a campaign for funds for the Center among attorneys throughout the country. Research in many legal subjects affecting the public and the legal profession will be carried on in the Center, which also will house the national headquarters of the American Bar Association and affiliated organizations.

The site for the building was donated to the Foundation by the University of Chicago. Architects for the Center are the firm of Holabird & Root & Burgee.

WSE Personals

Paul Rogers, MWSE, structural engineer and partner in the firm of Rogers and Snitoff, Inc., Chicago consulting engineers, was recently advised by the American Society of Civil Engineers that he will be awarded the J. James R. Croes Gold Medal. Rogers will receive the medal for his paper entitled "Design of Large Coal Bunkers," which appeared in Volume 117 of the ASCE Transactions. He will be presented the award in October at the convention in New York.

Henry L. Hoeppner, MWSE, formerly senior electrical engineer of Pioneer Service and Engineering Company, Chicago, became chief engineer of the company effective July 1.

Hoeppner received his bachelor's degree in Electrical Engineering from Tri-State College in 1917 and has done post-graduate work at Northwestern University and Illinois Institute of Technology.

After a period with General Electric Company and other employers, he joined Pioneer's organization in 1922 and has continued in its employ since that date. He is the inventor of the Grounded Delta Transformer. He is a Fellow in the American Institute of Electrical Engineers, besides being a member of the Western Society and the state and national Professional Engineers' societies.

Fred T. Whiting, MWSE, vice president of Westinghouse Electric Corporation, has announced a change in designation for the firm's operations in the midwest. The former Northwestern District was renamed the Mid-America Region.

"This was done," he said, "to provide a more appropriate description as befitting the economic importance to the nation of the area."

The Region is responsible in six states and parts of three others for the sales, service and repair of all products manufactured by the company.

Whiting also announced that a Chicago District office of the Region has been established.

He said the new organizational plan is designed to relieve staff managers of direct supervisory duties.

V. S. Acton, MWSE, has been appointed Regional industrial department manager of Westinghouse.

The election of **Ivan L. Hill,** associate professor of technical drawing at Illinois Institute of Technology, as president of the technical drawing division of the American Society for Engineering Education, was announced at the society's convention in Gainsville, Florida.

A member of the technical drawing division's executive committee during recent years, Hill is an active supporter of ASEE aims. The society is comprised of educators in the engineering field and is devoted to the exchange of new ideas and methods in engineering.

More than 1800 educators, engineers, and industrial representatives attended sessions held on the University of Florida campus. Representatives from Illinois Tech included: I. L. Hill; C. A. Arents, coordinator of research; J. A. Anderson, assistant professor of technical drawing; **F. W. Edwards,** MWSE, director of civil engineering; G. J. Matchett, associate professor of economics; **R. G. Owens,** MWSE, dean of engineering; E. G. Pare, associate professor of technical drawing; **H. C. Spencer,** MWSE, director of technical drawing; and S. E. Winston, dean of the evening division.

Francis H. Bulot, MWSE, for more than 30 years an engineer in the municipal and industrial fields in this country and abroad, has been named president of the newly formed Francis H. Bulot, Consulting Engineers, Inc., it has just been announced.

The firm, with offices at 411 West Fifth street, Los Angeles; 1041 East Green street, Pasadena and 116 East Broadway, Costa Mesa, California, will continue Bulot's practice on an expanded scale.

Dr. Gustav Egloff, MWSE, has been made a national director of the Armed Forces Chemical Association for 1953-54, and also a member of the Association's Advisory Committee, Midwest Chapter, for 1953-54. Dr. Egloff has also been elected an Honorary Fellow of the Royal Society of Edinburgh, Edinburgh, Scotland.

D. E. Inman, MWSE, veteran executive of the Westinghouse Electric Corporation, has been appointed engineering manager of general industrial products, it was announced by W. W. Sproul, vice president, recently in Pittsburgh.

Inman goes to his new assignment from the Westinghouse Chicago office where he has been district engineering and service manager for the company's Northwestern District, a post he held since July, 1949. In his new position, he will exercise staff supervision and coordinate the engineering activities of the general industrial products divisions.

A native of Iowa, Inman was graduated from Colorado Agriculture College in 1925 with a degree of Bachelor of Science in electrical engineering. He joined Westinghouse that same year as a member of the Graduate Student Training Course. After 10 years in the control engineering department, he was transferred to the Pittsburgh engineering division as a consulting and application engineer.

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Crerar Library

News and Notes

Mention in the public prints this spring has increased the already widespread knowledge of Crerar's facilities and services. On April 26, the *Chicago Sunday Tribune* devoted two columns to a feature story describing activities of the various departments, especially noting the benefits to industry provided through Research Information Service. The June 8 issue of *Newsweek* featured in their "Science" section a brief history of the Library, including the now famous prohibition against "French novels and all skeptical trash." Most recently *Commerce Magazine* leads off its July issue with an article on Chicago's library resources, covering the Newberry and Public Libraries, as well as Crerar.

* * *

One request frequently directed to technical and scientific libraries is for recommendation of the "best" journals in various fields. In some instances, a company desires to get up a small library; in others, an engineering school is developing its book collections and needs guidance. Published this month by the Association of College and Reference Libraries is a monograph entitled "A Recommended List of Basic Periodicals in Engineering and the Engineering Sciences." The list of 553 titles was prepared by 55 librarians from 43 institutions, assisted by a large group of faculty specialists and practicing engineers. Arranged in twelve subject sections covering all engineering fields plus mathematics and physics, selections range from 14 titles in Agricultural Engineering to 109 in Mining-Metallurgical Engineering and Geology. Of the 553 titles recommended, Crerar receives 480 currently; most of those not received are in fields outside the scope of the Library's coverage. Compilation was under the general editorship of William H. Hyde, Librarian, Illinois Institute of Technology; among those assisting in the work were Elizabeth Kientzle and William Budington of the Crerar staff.

* * *

Earlier announcement has been made in this column of the installation of a teletype machine in the Crerar Administrative Office (CG-1544). While its primary purpose is to provide communication with The Midwest Inter-Library Center and its other cooperating libraries to facilitate interlibrary loans, other interesting uses highlight this innovation in library equipment. Several companies outside the Chicago area, using Crerar's photoduplication coupons, now order photostats by TWX when urgently needed. In turn, Crerar is able to teletype the Library of Congress for photostats of material not locally available. Research Information Service contacts and is contacted by clients or interested parties in connection with projects; a research man on the West Coast recently made an appointment for consultation in this manner. A student at the University of Wisconsin whose thesis was due at 5 P. M., discovered at noon several incomplete references to literature not available at his school. Via the university library, TWX and Crerar provided the information needed to get the sufferer under the wire.

* * *

Persons using the Technology Department will be getting acquainted with Miss Elin Törnudd, who joined the staff recently as a Reference Librarian and who will also assist in RIS. A native of Finland, Miss Törnudd has the M. S. degree in Chemical Engineering from the Finnish Institute of Technology and the M.L.S. degree from the library school of Carnegie Institute of Technology. She has previously been employed as Librarian of the Central Chemical Association in Helsinki and is in this country on a year's study-work permit.

Argentinian Architects Win $5,000

Two Argentinian architects on temporary teaching assignments at North Carolina State College took top national honors and $5,000 in prize money in the Carrier Weathermaker Home Competition, it was announced May 15 in Syracuse, N. Y., by Edgar I. Williams, FAIA and chairman of a panel of judges.

Purpose of the competition was "to stimulate the design of year-round air conditioned homes in the moderate price bracket."

In the opinion of the judges the plan for a flat-roofed, one-story, five-room house submitted by Professors Eduardo Fernando Catalano and Horacio Caminos of the staff of the School of Design of the North Carolina College was the best of 855 entries submitted by architects, architectural draftsmen and students from all over the country.

The competition was the first national architectural ever held in which year-round air conditioning was a requirement. The competition was sponsored by Carrier Corporation, pioneer in air conditioning, which offered $27,800 in cash awards to interest architects and builders in homes designed especially to meet the requirements of the recognized trend toward year-round air conditioning of dwellings.

Catalano, 35, is a native of Buenos Aires and was graduated from the University there. He received his master's degree from the University of Pennsylvania. He was in private practice in Buenos Aires from 1940 to 1950, and is now acting head of the N.C. State School of Design and a visiting professor of architecture. He taught for a year at the Architectural Association in London. He has won several other awards in national architectural competition.

Horacio Caminos, 39, also a graduate of the University of Buenos Aires architectural school and a native of that city, was in practice in his home city from 1939 to 1952. He was chief architect of the University City of Tucuman from 1947 to 1952. At present he is a visiting professor of architecture at N.C. State. He, too, taught for a year at the Architectural Association in London.

On the distaff side of the team is Mrs. Catalano, also an architect. She drafted the winning plans.

Three leading architects, a builder and a housewife made up the panel of judges. Architects were Edgar I. Williams, New York City; Pietro Bolluschi, dean of Massachusetts Institute of Technology's school of Architecture, and Richard J. Neutra, Los Angeles. All are members of the American Institute of Architects. Edward G. Haeger, director of research and technical services of the National Association of Home Builders, was the building consultant. Mrs. Lillian M. Gilbreth, industrial engineer, whose life was amusingly described in the best seller, *Cheaper By the Dozen*, was the housewife.

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Industrial Hydraulics Program Set

The program for the ninth National Conference on Industrial Hydraulics at the Sheraton hotel, October 8 and 9, was announced in Chicago on June 25 by conference secretary John G. Duba, MWSE, assistant professor of civil engineering at Illinois Institute of Technology.

John T. Rettaliata, MWSE, president of Illinois Tech, will welcome the conference in behalf of the conference sponsors, Armour Research Foundation and Illinois Tech. After the opening remarks, papers on various phases of industrial hydraulics will be presented.

The general session will be led off by W. P. Green, Armour Research Foundation, who will present a paper on "Friction and Wear Phenomena."

The automotive session will consist of papers on "Hydraulics Applied to the Automobile Suspension," by R. R. Peterson, Chrysler Corporation, Detroit, Mich.; and "Hydraulic Mechanisms for Operating Auto-window Lifts, Convertible Tops, and Similar Mechanisms," by C. L. Kalitta, Warner Division, Detroit Harvester Company.

E. V. Crane and W. R. Jackson, E. W. Bliss Company, Canton, Ohio, will present their answers to "Hydraulic Problems on Large Forging Presses." Finishing the presses session will be a paper by A. J. DeMatteo, Watson-Stillman Company, Roselle, N. J.; "Self Contained Pump Units as Applied to Extrusion Presses."

"Boiler Feed Pumps," by O. M. Kristy, Allis-Chalmers, Milwaukee, Wis.; and "Ball Piston Pumps and Motors," by H. Stern and W. T. Rauch, General Electric Company, Schenectady, N. Y., will comprise the pumps session.

John Pelz, Bendix Aviation Corporation, South Bend, Ind., will present his findings on "Aircraft Variable Delivery High Pressure Fuel Plunger Pump" to the aircraft session.

Components session discussions will be on "Fluid Carriers for Hydraulic Units in Earth Moving Equipment," by John Jass, Caterpillar Tractor Company, Peoria, Ill., and "Factors in Design of Mechanical Seals and Applications to Hydraulic Equipment," by Justus B. Stevens, Jr., and Harold Greiner, Sealol Corporation, Providence, R. I.

Machine tools session papers will be: "Hydraulically Operated Test Table with Three Degrees of Freedom," by G. F. Warnke and S. Hori, Armour Research Foundation; and "Hydraulic Applications in Paper and Paper Processing," by Ranson Tyler, The Oilgear Company, Milwaukee, Wis.

"Industrial Application of Non-Flammable Hydraulic Fluids," by D. Milne, General Motors Corporation, Detroit, Mich.; and "The Effect of Synthetic Fluids on Hydraulic Components and Circuits," by James Robinson, Vickers, Inc., Detroit, Mich.; will be the two papers read during the non-flammable fluids session.

Papers telling of the "Hydraulic System of the Golden Jubilee Ford Tractor," by Harold Brock, Ford Motor Company; and "Hydraulic Actuation of the TD-24," by W. W. Henning, International Harvester Company, Melrose Park, Ill.; will comprise the tractors session.

The instrumentation session will consist of papers on, "Pressure Transducers," by R. E. Boyar, Askania Regulator Company, Chicago, Ill.; and "A Flowmeter for Measuring Mass Flow-Rate with High Speed of Response," by Dr. Yao Tzu Li, Massachusetts Institute of Technology, Cambridge, Mass.

ASME Metro Section in N.Y. Elects Officers

Harry Knecht, assistant mechanical plant engineer at the Consolidated Edison Company, has been elected chairman of the executive committee of the Metropolitan Section of The American Society of Mechanical Engineers. Other officers elected at a meeting on June 18 are Allen T. Kniffen, project engineer at the Air Reduction Company, secretary; Henry J. Scagnelli, engineer at the Ward Leonard Electric Company, treasurer; and Miss Muriel O. England, who was re-elected assistant secretary-treasurer.

V. Weaver Smith, vice president of The Lummus Company, was made a Fellow in the society. The award, for outstanding contributions in the mechanical engineering field, was presented by Henry R. Kessler, vice president of the society and manager of Republic Flow Meters Company.

Reviews of Technical Books

Servomechanisms

Servomechanism Analysis, by George J. Thaler and Robert G. Brown, McGraw-Hill Book Co., New York 18, N.Y. First Edition 1953. 414 pages. $7.50.

The introduction to the basic principles and concepts involved in the treatment of the subject is followed by review material on the Laplace transformation and equations of physical systems.

The principal tools for the analysis and design of servomechanisms, with the emphasis on analysis, is presented in chapters two through twelve. A special chapter on "Relay Servomechanisms," as well as a chapter on the "Root-Locus Method" of analysis, have been included.

The problems at the end of the chapters are a valuable part of the book. The solution of appropriate problems by the student will always increase his understanding of the subject.

The component material presented in the appendices and the extensive bibliography given as an appendix are valuable sections of the book.

The material in this book is well arranged. The book is suitable as a text for advanced undergraduate and graduate instruction. In addition this book should be valuable to the engineer who is interested in the subject but has not had the opportunity to take a formal course in it.

R.G.O., W.S.E.

Kinematics

Applied Kinematics, by J. Harland Billings, D. Van Nostrand Co., Inc., New York 3, N.Y. Third Edition 1953. $4.50.

Basic material for the study of mechanisms is presented in logical order in the first seven chapters of this book with the exception of Chapter Four which is a discussion of parallel and straight-line mechanisms.

This third edition has been made more valuable through a rewrite of portions of a number of chapters and the addition of a new chapter on automatic control and its mechanisms.

Many new problems have been added at the end of chapters and a series of "Problems for the Drafting Room" has been added in the Appendix.

In addition to its use as a student text, this book with its many illustrations and problems could be used as a reference to great advantage by practicing engineers who may have forgotten some of the material.

R.G.O., W.S.E.

Electronics

Industrial Electronic Engineering, by Wells L. Davis and Herman R. Weed, Prentice-Hall, Inc., New York, New York. First Edition 1953. 514 pages, $8.50.

In order to read this book one should have a knowledge of a-c circuit theory, elementary theory of electronic circuits and elementary differential equations. Additional background material for this book is presented in Chapter One "Gas Tube Characteristics."

Basic methods of analyzing and solving problems are stressed and a number of examples are included.

In general the material in the chapters are independent and hence the order of consideration by the instructor or reader may be to their own choosing.

The problems at the end of the chapters are a valuable part of the book. This book may be used for instruction of electrical engineering students who are sufficiently advanced to have the background material as stated above or as a reference by the electronic engineer who may need assistance in special problems from time to time.

R.G.O., W.S.E.

A. C. Machinery

Principles of Alternating-Current Machinery, by Ralph R. Lawrence. Revised by Henry E. Richards, McGraw-Hill Book Co., Inc., New York 18, N.Y. Fourth Edition 1953. 623 pages. $7.50.

The order of presentation of the material in this edition has been rearranged. Part One which includes the first twelve chapters deals with static transformer theory. This represents a change in thinking on the part of the author since he in the Preface to the first edition indicated that experience had shown the beginning student was able to grasp the principles of the alternator more readily than those of the transformer.

New chapters have been added in the discussion of the power mercury-arc rectifier and the polyphase antotransformer.

A noteworthy addition to this edition is the problem section. Those of you who are convinced that the solution of problems is a necessary part of learning the subject will consider it an improvement.

Many students have used this book as a text since the first edition appeared in 1916. Each edition has had changes which has made it more desirable for use as a text in electrical engineering classes.

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High Speed Movies Called Engineer Aid

When an industrial engineer knows what a machine can do, but can not prove it; or when he has proven on his drawing board what should not happen, and it does; it is time to call in a high speed photographer.

Nelson Rodelius, assistant physicist, Armour Research Foundation of Illinois Institute of Technology, offered that advice in a speech before a meeting of the Society of Motion Picture and Television Engineers at the Engineers Club in New York City on June 25.

Speaking on "High Speed Photography in Education and Industrial Research" Rodelius said, "An engineer may be completely in the dark when some piece of perfectly designed machinery breaks down or functions improperly. Normal observations of the machine in action is usually unsatisfactory due to the high speed of the operation."

Rodelius went on to explain the scope of experimentation at the Foundation and how industry and education can benefit from research. "It's the designer, the mechanic, the educator and countless others who can be informed every day by high speed photography.

"Employee morale can be built up and maintained through films which can show how the machines they operate actually function. There are even possible applications of the process in advertising and public education.

"Speeds of 16,000 pictures a minute, although slow for some research purposes, can be used to detect most malfunctions in mechanical devices moving at high speeds. Thousands of man hours can be saved by the process."

Rodelius urged industry to encourage technical schools to include the study of high speed photography as a regular course towards a bachelor of science degree.

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Request Rate Increase

Commonwealth Edison Company has asked for the first general rate increase in its 66-year history. In the case of the average residential electric customer of Edison and its Public Service division (who uses 161 kilowatthours a month) it would amount to approximately 50 cents a month.

The Company filed new rate schedules with the Illinois Commerce Commission fixing increases totaling approximately $16,450,000 annually for its 1,725,000 electric customers in Chicago and northern Illinois. The schedules also provide increases amounting to $2,900,000 for the 435,000 gas customers outside Chicago served by Public Service. These amounts are based on operations for the twelve months ended April 30, 1953.

The electric and gas increases will each average about 6.5 per cent.

Against its 66-year history of no general rate increases, Edison has had 26 electric rate reductions. Public Service had two increases resulting from the inflation of World War I as against 37 electric rate reductions and important gas rate reductions during its 42-year corporate history.

Clear Span Roofs O.K.'d by Housing Administration

Home builders now can benefit from all the advantages of clear span roof construction, as a result of the Federal Housing Administration's recent revision of its requirements for installing partitions in one or two-unit dwellings, according to Alden K. Smith, sales manager of Timber Engineering Company, research affiliate of National Lumber Manufacturers Association.

In its revision No. 40 to MPR 408-G-3, released recently, FHA cancelled the traditional requirement that the top plate of nonbearing partitions must lap over the under plate of the exterior wall.

"FHA's cancellation of this requirement enables builders to have, for the first time, full benefits for which clear span construction was designed," said Mr. Smith.

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OVER THE MANAGER'S DESK

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Now is the time for you employers to throw your line out and hook that engineer you have been looking for. E.S.P.S. has a lot of good bait. J. H.

POSITIONS AVAILABLE

C-1107 METHODS ENGINEER—Age: to 40. 10 yrs. plus exp. in methods and process work. Knowledge of automotive manufacturing. Duties: charge of methods, processes, production and cost systems for automotive manuf. Salary: $6000 to $7500. Loc: Chicago.

C-1106 PLANT ENGINEER—Grad. Mech. Age: to 35. 0-5 yrs. exp. in plant engineering. Duties: plant engineer in plant employing 400. New position in company working under supervision of central, engineering office on plant maintenance, plant layout, machine and equipment design, manufacturer of plastic and asphalt tile. Salary: $390-$450. Employer will negotiate fee. Location: Chicago.

C-1105 SALES ENGINEER—Grad. Mech. Age: 25 plus. 1 plus year's exp. in sales on engineering preferably pumps or material handling equipment. Duties: sales engineering assist salesmen in selling line of pumps and conveyors. Must be aggressive and have good personality. Salary: $350 base plus $150 expenses. Employer will pay fee.

C-1104 FIELD ENGINEER—Age: 27-40 C. E. 3 plus years exp. in design of construction of municipal paving work. Duties: field engineering work, promotional activities calling on engineers, contractors, and public officials. Salary: $500-$600 per month. Employer will negotiate fee. Loc.: Chgo.

C-1102 SANITARY ENGINEER—Grad. C. E. or San. Age: 35 plus. 5 years exp. in laying out municipal sewage and sanitary plants. Duties: complete layout of sanitary plants for municipalities. Good personality able to talk to city managers, public officials, etc. Salary $10,000 to $12,000. Loc.: Chgo.

C-1099(a) TOOL DESIGNER—ME Age: up to 40 3 plus yrs. exp. in tool design and machinery for production. Knowledge machine tools. Duties: design tools, dies, jigs and fixtures for production equipment. For a forging manufacturer. Salary: up to $600 per mo. Employer will pay fee. Location: Chicago.

C-1099(b) WELDING ENGINEER—Eng. or Metal Eng. Age: up to 28. Recent graduates may be considered. Knowledge of submerged weldment. Duties: assist welding engineer or recommend welds, equipment, etc. Salary $85-$90. Employer will pay fee. Location: Chicago.

C-1098 DESIGNER—STRUCTURAL—Grad. Structural or Civil Engr. 5 plus yrs. exp. Duties: must be licensed structural engineer in State of Ill. Duties: will be designing structures for electrical substations. Salary: About $8400/yr. Empl. will negotiate fee. Location: West Suburb.

C-1097 SALES—Age: up to 50. 2 plus yrs. exp. in mechanical stamps or stampings and preferably in sales. Knowledge: prints and shop practices. Duties: sell a line of metal clamps to O.E.M.'s and industrials in general. For a Manufacturer's dept. of metal products. Sal.: $500 month and commission. Location: Indiana. Employer will pay ½ fee. Travel 35% and car required.

C-1096 INDUSTRIAL ENGINEERING TRAINEE—Grad. I. B. or M.E. 0-2 yrs. exp. in mechanical or industrial engineering. Duties: training program in methods, incentive application and production methods, general training program for eventual key management position for food canner. Salary: to $400 per month. Location: Chicago.

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FACTORY MGR. MSMet. 37 Five yrs. supervised plant with four distinct operations. Three yrs. research engineer charge of three projects. Four yrs. Process development, trouble shooting and research U.S. $12,000 668 MW

DEVELOPMENT EE 27 Thirty-three mos. Project Eng. clearing up inherent design difficulties, plan assembly sequences, draw up test chart, and process engineering. Midwest $5200 669 MW

DESIGNER AERO 27 Three yrs. design and layout of new implements and associated machinery. $5100 Midwest 670 MW

SURVEYOR Mine Engr. 28 One yr. Mine management and engineering surveying, purchasing, time and cost keeping. $3900 Midwest 671 MW

CHEMIST CH. E. 38 Eleven yrs. Chief Chem., set up lab., train men, development of methods of analysis, set up procedures on ferrous & non-ferrous alloys, ores, water, coal, etc. Midwest $9000 672 MW

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175 W. Jackson Blvd., CHICAGO, *And All Large Cities*

MUNCIE CONSTRUCTION CORP.

Contractors
for
Utility Maintenance
and
Construction
Transmission Lines
Substation
Distribution Systems
Plant Electrical

201½ East Adams Street,
Muncie, Indiana

THE
HAINES
COMPANY

Ventilation &
Air Conditioning Contractors

Sheet Metal Fabricators
— Welding —

1931 WEST LAKE STREET
CHICAGO 12, ILLINOIS
SE eley 3—2765

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Help the Society help you!

Keep it posted on changes in your status

To make sure we have you listed correctly,

MAIL FORM TO THE WESTERN SOCIETY OF ENGINEERS
84 E. Randolph St., Chicago 1, Ill.

Name:.....

Position:.....

Firm:.....

Firm Address:.....

Home Address:.....

Home Phone:..... Business Phone:.....

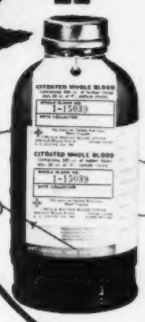
Here's what happens to the blood you give to the NATIONAL BLOOD PROGRAM *THROUGH your Chicago Chapter American Red Cross*

"O"-TYPE BLOOD
universal type

OTHER BLOOD TYPES

TO KOREA AS WHOLE BLOOD
BY AIR WITHIN 4 DAYS

Processed into



BLOOD PLASMA *or*

SERUM ALBUMIN
and
GAMMA GLOBULIN

BOTH
processed from
a pint of blood

THIS IS WHY BLOOD IS AMERICA'S MOST PRECIOUS NATIONAL RESOURCE

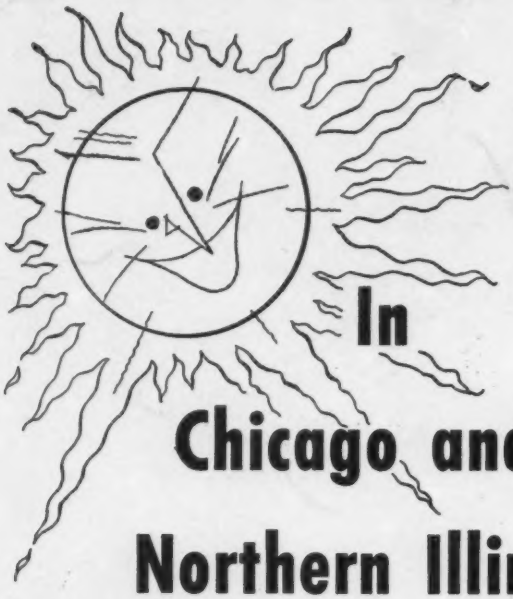
WHOLE BLOOD—The acme of therapy; replenishes body's oxygen supply; combats shock; can be preserved 21 days under refrigeration.

BLOOD PLASMA—Combats shock; can be preserved five years.

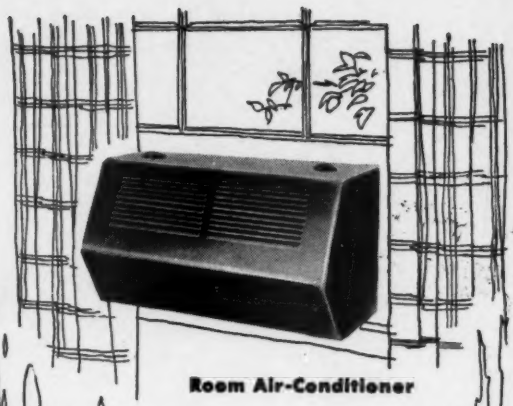
SERUM ALBUMIN—Combats shock; can be preserved five years.

GAMMA GLOBULIN—Effective in minimizing polio paralysis; preventing measles; used to treat infectious hepatitis; can be preserved one year.

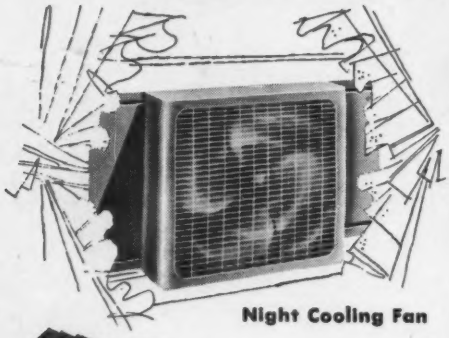
Prepared by—Public Information Department
Chicago Chapter, The American Red Cross



In Chicago and Northern Illinois—

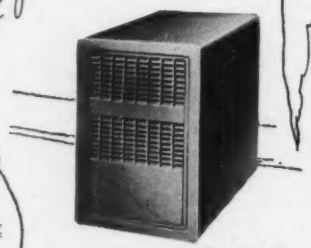


Room Air-Conditioner



Night Cooling Fan

ELECTRICITY is your BIGGEST HOUSEHOLD BARGAIN!



Dehumidifier

COMMONWEALTH EDISON COMPANY

PUBLIC SERVICE COMPANY